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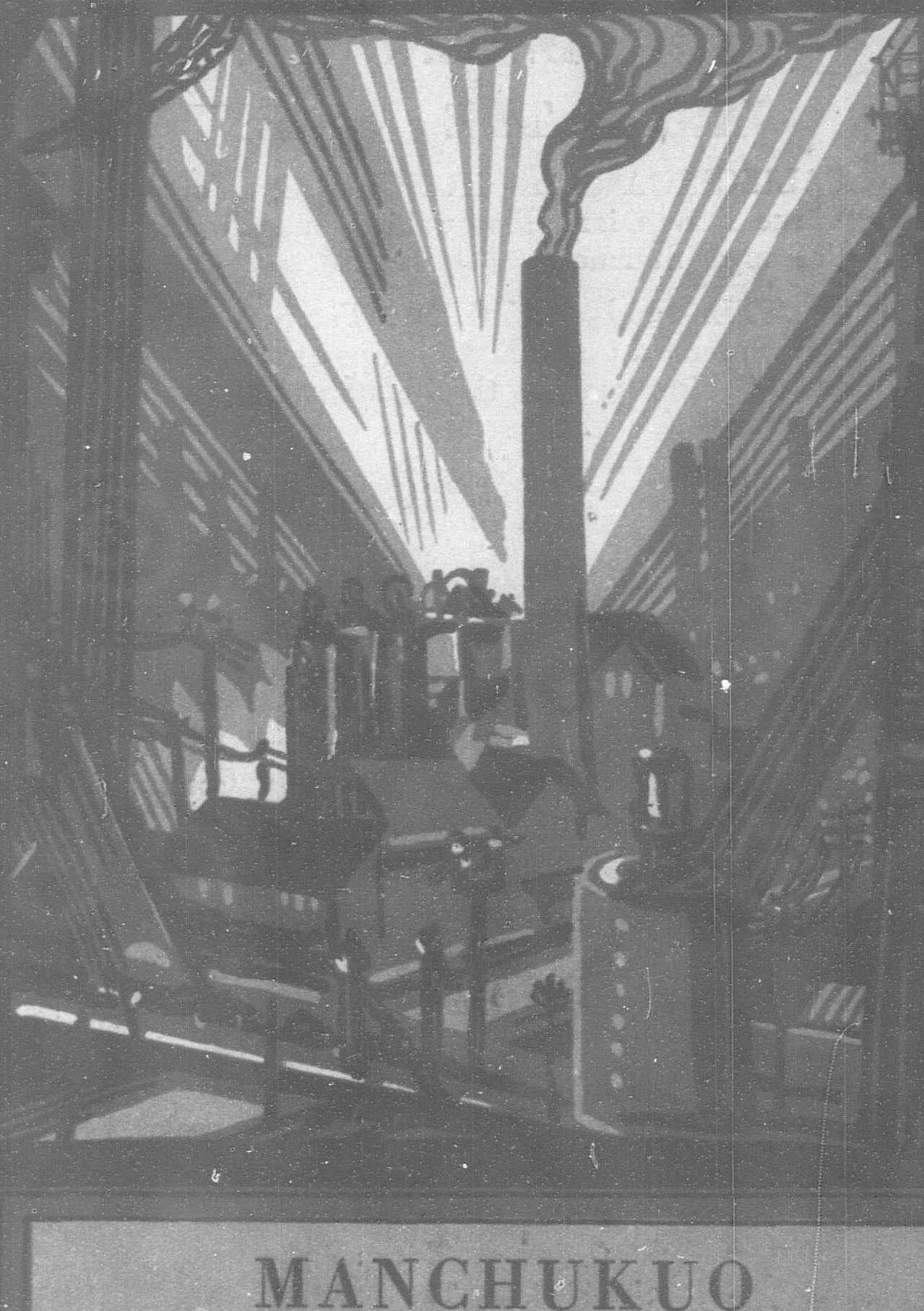

MANCHUKUO

By GEORGE BRONSON REA

What Price Postal Bans—Boycotts—Warfare?

JEHOL PROVINCE

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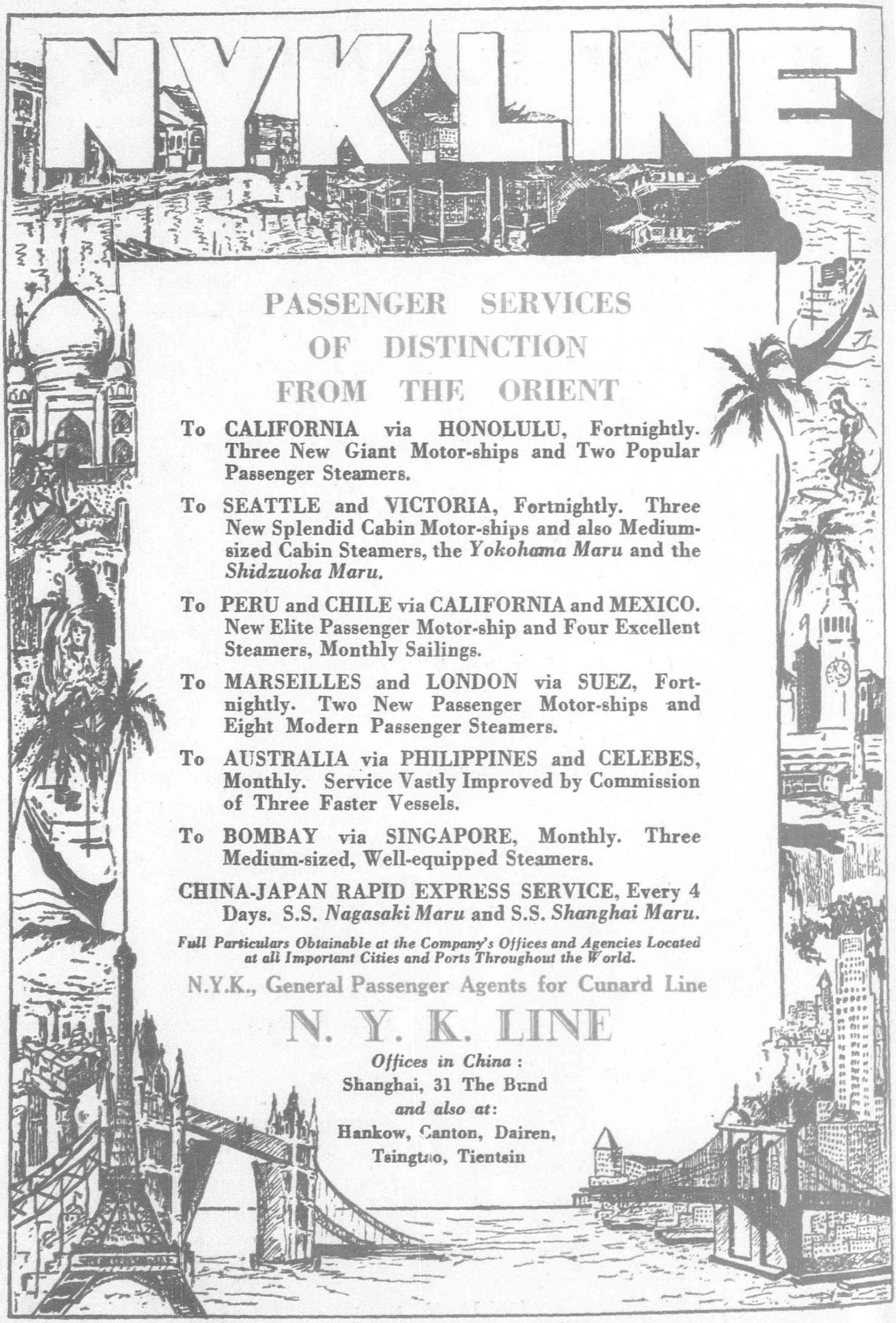

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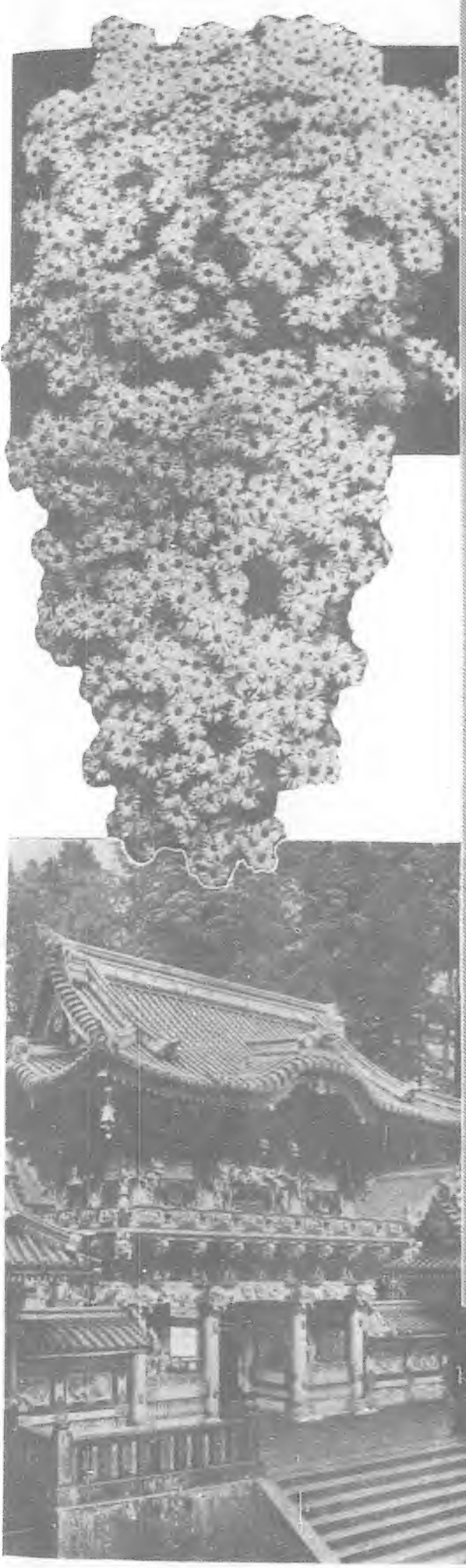

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MANCHUKUO

Back to First Principles!

Following is the address delivered by GEORGE BRONSON REA, Counsellor to the Ministry of Foreign Affairs of the Government of Manchukuo before an assembly in the Hall of the Athenee at Geneva on October 14, 1932

THE people and the Government of Manchukuo hope that their official representative will be permitted to present formally their case to the Council and Assembly of the League before the session closes, for, no matter what decision is arrived at in the dispute between China and Japan, Manchukuo will remain an independent state.

It is a high honor to stand before you in this building where the Red Cross Society was founded. In this center of Humanitarianism, the cry of distress from the despairing millions of China will, I am sure, be heard with sympathy and respect. I feel that in laying before you the case for Manchukuo from a forum sanctified and hallowed by those who have kept the torch of human progress, tolerance and liberty burning brightly in Europe, that you will grasp the underlying facts which transform a political dispute into a great humanitarian problem involving the happiness of one quarter of the world's population; oppressed, harassed, outraged and held in salvery by a so-called system of government more callous of human rights and more contemptuous of world opinion than any recorded in modern history.

Adjoining this center of Humanitarianism is the Wall of Remembrance, one of the memorable monuments of the world, with the majestic figures of the Great Reformers (Calvin, Farel, Beze, Knox, Coligny, Henry IV of France, William the Silent, Frederick William, the Great Elector, Roger Williams, Cromwell and Stephen Bocskay), symbolizing the spirit of freedom and tolerance that brought light into a world of darkness. On that wall, in letters of enduring stone are engraved deep the fundamentals of Human Liberty and the text of that Bill of Rights extracted by the Lords and Commons of England from William and Mary which stand to-day as the basic law of Self-Government and of Democracy, the Bulwarks of our Civilization. Treaties and covenants which contravene these indestructible principles; which deny to oppressed peoples their inalienable right to rebel against tyranny and set up their own government, constitute a betrayal of those almighty principles for which countless millions of our forebears have sacrificed their lives. In these surroundings, it is peculiarly fitting to plead the cause of the people of Manchukuo

It may seem somewhat unconventional for an American to present and defend the cause of Manchukuo when the report of the League Mission of Enquiry concludes that the new state is an instrument of the Japanese and created in violation of the treaties and the covenant. It may also strike you as paradoxical that an American citizen should defend a cause that seemingly is opposed to the policies of his own government and in contravention to the peace treaties and other instruments for the establishment of a new world order.

I make no apologies for appearing in this birth-place and home of freedom and independence as counsel in defense of a cause that in my humble and considered opinion represents all those ideals and principles upon which human liberty and progress are founded. It has been said that the creation of the new state of Manchukuo violates the letter of some of the international agreements upon which we hope to erect an edifice of lasting peace and justice, but unless these instruments of the new dispensation are based upon those almighty and eternal principles of Humanity, Civilization and the inalienable rights of a people to assert their right to life, liberty and the pursuit of happiness, the edifice will not endure.

Manchukuo's Right to Independence

The Government and the people of Manchukuo are not interested in the dispute between China, Japan and the League. They stand on their unquestionable rights as human beings to rebel against injustice, oppression and misrule and set up their own government. They demand the right to exercise that same principle of self-determination which the Powers and states of Europe appealed to in order to safeguard their own liberties and conception of security. The people of Manchukuo assert and will defend with every means in their power their right to secede from a system which has enslaved, impoverished, outraged and denied to them their fundamental rights as human beings. They contend, and rightly so, that there are no covenants, treaties, conventions, policies or laws that can deprive them of these basic rights and that they are clearly within the moral and unwritten law in declaring their independence of the chaos, anarchy and slaughter recognized by the foreign powers as the Government of the Republic of China.

Treaties are Not Violated

It may be that the treaties and the Covenant have been violated by Japan in resorting to self-defense to protect her interests in Manchuria. That, however, remains a matter of opinion, one which concerns the League and the co-signatories of those treaties and must be adjudicated between them and Japan. The dispute does not concern the people of Manchukuo. It does not in any way nullify the rights of the people of Manchukuo to a voice in their own affairs and to take that right into their own hands.

It may be that Japan intentionally or otherwise created a situation that gave rise to the opportunity for the people of Manchukuo to secede from a government which had never exercised jurisdiction over them and redeclare their independence of the rest of China. It may be that the presence of Japanese troops in Manchuria has encouraged and assisted the people of the Three Eastern Provinces to free themselves from their military overlords and set up their own government. We are told that the world cannot recognize that independence because it was made possible through the application of force on the part of Japan in defense of her own rights. We do not deny that this military intervention created the opportunity for the people of Manchukuo to assert their right to self government; but is that an infraction of the treaties or a violation of international law?

Precedents Justify Manchukuo

Every people who have achieved their independence have done so with help from the outside. The United States would still be a colony of Great Britain had it not been for the timely assistance of France, a debt we recognized and paid in full when Pershing, uncovered, stood before the silent tomb in Paris and said, " Lafayette, we are here ! " The Cubans had carried on a war of independence for five years and were slowly being starved into submission when the United States in the name of Humanity went to war with Spain and gave to the Cubans their liberty. But we did not immediately hand over the island to a people unprepared to enjoy their independence. The United States kept them in tutelage for four years under a benificent military régime which taught them how things should be done and, when in its opinion the time was opportune, it created the electoral machinery and supervised the voting which placed in power a government committed to a treaty and conditions which perpetuates for all time its dependence upon the United States in certain major international policies. We went even further and to each department of the new government was attached an American adviser. Is it necessary to recall how the independence of Panama was created or how Nicaragua was induced to sign treaties which concede to the United States canal rights deemed essential to its security ?

It is true that the other Latin American Republics achieved their independence through their own exertions, but how has that independence been maintained and guaranteed for over a century ? What would have been the fate of Mexico, of Venezuela and other Central and South American states, had not the Monroe Doctrine protected them from aggression ? Whether they wish to admit it or not, that Doctrine still stands as their one security against aggression. In this respect they are much " protected states" as though they had entered into a hard and fast alliance with the United States. How did the new post-war states of Europe achieve their independence ? Carved out of the old Central Powers, out of Turkey and Russia in order to safeguard the security and peace of Western Europe, the peoples of these states were permitted to exercise their right of self-determination and establish themselves as going concerns under the protection of the League of Nations. Can the representatives of Poland, Czecho-Slovakia, Jugo-Slavia, Esthonia, Latvia and Lithuania stand up in the League of Nations and deny to another oppressed people the rights upon which their own national liberty and independence were predicated ?

Principles which Apply in Europe. Must also Apply in Asia

In outlining the principles and conditions of settlement for the dispute between China and Japan, we find the League Commission of Inquiry greatly concerned for the interests of Russia. Now Soviet Russia is not a member of the League. The Powers gathered at Versailles had no scruples about amputating large chunks of territory out of the main body of Russia in order to create a group of new states that would serve as a buffer against Bolshevism and guarantee the peace and security of Europe. Yet, when Japan in sheer desperation and in self-defense makes possible a situation for the people of Manchukuo to set themselves up as an independent state and enter into an agreement with Japan for mutual self-defense against the same menace, we find a League Commission suddenly solicitous for the interests of Russia. A principle that applies in Europe as one of the fundamentals of peace and security and which forms part of the League's charter, must apply with equal force in Asia when the peace, security and happiness of another League Member is imperilled. Otherwise, the principle is discriminatory and unjust, If adhered to, it can only result in disaster to the League and the cause of world peace.

As spokesman for the people and government of Manchukuo, I make the simple statement that if the continued independence of the new post-war states of Europe is deemed essential to the preservation of peace in this continent, then the independence of Manchukuo and the strengthening of its powers of defense is also imperative for the preservation of the peace of the Far East and for the same reasons. The independence of Manchukuo is an accomplished fact. We cannot turn back the clock. Are we now to promulgate at this late date a new theory or principle of international law as to how, when and where assistance from the outside is to be extended to an oppressed people, in order to legalize their new status and justify our recognition of their government ? Are we to deny to oppressed peoples in Asia or other parts of the world their right to take advantage of an opportunity to free themselves from despotism, simply because this opportunity conflicts with some political formula or treaty provision ? If so, there is an end to human progress. National boundaries as they now exist will become frozen and there can be no escape for the oppressed from the despotism of militarism, once it has seized the reins of government.

For the League to declare that it will not recognize any change in the *status quo* in China that may have been brought about by force, is only another way of saying that it has surrendered and subordinated the principles which underlie the basic precepts of humanity and civilization to a diplomatic formula which closes the door of hope and equal opportunity to one quarter of the world's population, handing them over bound hand and foot to a system of government more callous of human rights and liberties than any recorded since the Dark Ages.

The Terror in China

The report of the League Mission of Inquiry concludes that there is no general Chinese support for the Manchukuo Government, being regarded by the local Chinese as an instrument of the Japanese. It denies that the new government is representative of the people. How the members of the Commission arrived at this conclusion is difficult to ascertain, for the simple reason there is no machinery for registering the will of the people of China. Such machinery has never existed. Every political dispute in this so-called republic has been settled by the sword. Untold millions of poor, ignorant, peaceful, inarticulate human beings asking only the right to live, have been ruthlessly slaughtered or in other ways done to death in order to impose upon their survivors the yoke of some military overlord or bandit leader. More people have been killed in China in the last ten years than were killed in the World War. The slaughter still goes on.

The National Government officially announced in June that in three months of this year over 500,000 people were killed or reported missing as the result of the Communist suppression campaign in the province of Kiangsi alone. Poor, hungry people, who accepted any leaders who promised them a release from their misery. For this they must be mowed down by machine-guns, in order to perpetuate the rule of military overlords whose only conception of government is their own enrichment. The cries of distress, of human misery that in any other country would be heard throughout the civilized world are drowned in the welter of political propaganda. The laws of Humanity do not extend to China.

Unfortified cities have been bombed, stormed, sacked, burned and the whole population, men, women and children, put to the sword. The leading merchants and officials have been tortured and murdered, the women outraged and the youngest carried off to be the slaves and playthings of the soldiers. The almost incredible barbarities, licentiousness and bestiality which marked the occupation of towns in Central China by the so-called Communist armies have no parallel in modern history. We have seen the armies of a war-lord driven back into the provinces of Shensi and Shansi where they confiscated the crops and even the seed grain of the people, causing a famine in which five million people perished. We have seen the young women of these provinces sold by the thousands to the brothels of the coast cities and taxed ten dollars a head as the unfortunates passed through the likin stations on their way out of the province to a life of slavery and shame. We have witnessed horror upon horror succeeding each other in rapid succession. We have seen the armies of China grow in the last two decades from the original Peiyang model divisions to a horde which now numbers three million men and we have seen banditry grow by leaps and bounds and develop in places into a spurious communism until to-day it is estimated that there are at least two million of these gentry roaming the countryside. For every soldier there seems to be a bandit. The five hundred million people of China, who twenty years ago were peaceful and contented have been transformed into slaves of a military system recognized by the Powers and the League as worthy of a seat in its Council and a voice in its deliberations.

Slaves of the War-Lords

Yet in all these years we have not heard one pacifist, one League enthusiast, one outstanding philanthropist or humanitarian, one missionary or one spokesman for the common people of China denounce publicly these atrocities and high crimes against Humanity and Civilization.

I am speaking now for these people of China, for these thirty million inarticulate peasants of Manchuria, whose side of the story has never been told from a public forum in Europe. You have heard from the official minority who constitute the electors of China, whose bullets, bayonets and bombs take the place of the vote in a country which claims to be a republic. The people of China have no voice in the management of their own affairs. The people of Manchuria have never been consulted or permitted to express their wishes or even voice a mild protest against the system which held them in bondage to a tyranny maintained by an army of 400,000 men. Any outspoken criticism or opposition to the rule of the bandit oligarchy meant swift decapitation or the firing squad. How then was it possible to ascertain the will of these 30,000,000 people who knew nothing and cared less about politics, whose only desire was to live in peace and be permitted to enjoy the fruits of their labor ? Why, these people are ignorant even of their rights as human beings, let alone their rights and duties as citizens of a republic. How was it possible after a two months superficial investigation to declare off-hand that the people of Manchuria are opposed to the overthrow of a system which held them in abject slavery ? To state the case, is to refute the conclusions arrived at by the commission. To accept the conclusion of the Commission is to endow the people of Manchuria with a sense of such overpowering patriotism that they are content to remain slaves under their taskmasters rather than accept any assistance from the outside that would release them from bondage and misery. Human nature is not like that ; no matter how strong the sentiment of nationality or the ties of race.

How the People of Manchuria were Impoverished and Enslaved

The case for the people of Manchukuo is simple enough. The prosperity of the country consists of its soya-bean crop, which averages five million tons a year. Of this, over three million tons are exported, chiefly to Europe. Over a period of years the average price in London was Y.100 per ton. Deducting Y.40 for ocean and railway freight charges, this left about Y.60 in Harbin, or roughly Y.200,000,000 that came into the country from the outside. This crop and the receipts therefrom constituted the main wealth of Manchuria. In the old days, the farmers brought their beans and other crops into the open market, sold them to the foreign exporter or middleman and received the full market price in real money. The farmer got the money and was happy and prosperous. When the military overlords needed a few million dollars they could raise it without placing any great extra burden on the people. During those halcyon days, Manchuria was conceded to be the most prosperous part of Asia.

The change in the fortunes of the province came about ten years ago when Marshal Chang Tso-lin became imbued with the idea of extending his sway over the rest of China. To carry out his ambitions, he increased his armies, built the largest arsenal in Asia and started on his career as a conquerer. The slender revenues of Manchuria were not sufficient to meet these heavy war demands, so Marshal Chang conceived a new idea in confiscatory taxation. He prohibited the farmer from selling his beans direct to the foreign exporter and compelled him to bring his produce in to certain designated centers to be sold exclusively to his official organization. He imported some new printing presses and tons of paper and started to turn out beautifully engraved notes which he issued as legal currency. The farmer brought his beans into the purchasing centers and received in exchange these worthless pieces of paper. Chang got the beans, sold them for gold and put the gold in his pocket, or his treasury, which is the same thing. The scheme worked. By the end of last year there was something like the equivalent of six billion silver dollars in these inconvertible paper notes in the hands of the people. As long as the foreign demand for beans held good and the price was high there was a certain reserve behind these notes. The bean crop and the stocks in hand represented this reserve. But, when the demand declined and the bottom dropped out of the market, this reserve was wiped out. This happened last year. Instead of three million tons only two million were exported and the price dropped to twenty yen a ton in Harbin. So instead of a revenue of Y.200,000,000 as in former years, only Y.40,000,000 entered the pockets of the military oligarchy. Now the year previous, the Young Marshal had embarked upon another campaign of conquest by occupying Peking and North China with his army at a time when the other combatants in a bloody civil war were exhausted and could offer no resistance to his invasion. Marshal Chang Hsueh-liang found himself holding down a conquered province with an army of 150,000 men dependent upon the revenues of Manchuria for their maintenance.

The great drop in the value of the chief export crop practically cut off these revenues and compelled him to squeeze the country dry to make up the deficit. Even his own associates in Manchuria protested against an adventure that was impoverishing the country and demanded that he return to Manchuria and attend to his own business. A deep current of unrest was noticeable in all parts of Manchuria, especially amongst the farmers, the holders of the billions of notes which were now worthless. These farmers found themselves impoverished, their purchasing power destroyed and reduced to the status of slaves, compelled to hand over the product of their toil in exchange for more worthless pieces of paper which could not buy the necessities of life. All the wealth of the province was being confiscated in order to maintain a huge army, one part of which was then holding down a conquered province south of the Great Wall and the other holding the people of Manchuria in subjection in order to provide the funds which perpetuated their bondage.

An Ominous Situation

The situation was fraught with grave dangers. The people were ripe for revolt. It is necessary to understand just what this implied in such a community and at such a time. Across the border of Manchuria lies Soviet Russia where a similar system of human slavery is enforced upon the people by their Communist leaders. The peasants and workers of Russia toil for the state and receive in compensation a meal ticket or rouble notes exchangeable only in the government stores. The rulers of Russia, however, believe they are working towards an ideal, which, if attained, will bring a larger measure of contentment and prosperity to these toiling masses. The proceeds of their toil goes to the state and is expended in schemes for their material and cultural betterment. There is little or no graft in Russia. No huge fortunes have been accumulated by the commissars.

Northern Manchuria is a Soviet sphere of influence, infested with Communist agents and agitators encouraging the people to revolt. It is only a step across the dividing line between the confiscatory labor system of the Manchurian war-lords and the system of the Soviets, with all the advantages on the Soviet side. Conditions in Manchuria had reached that point where it would have taken very little persuasion to induce the impoverished farmer to espouse the cause of Communism and, with Northern Manchuria in the hands of the Communists, Southern Manchuria would have been swept into the fold.

With this background, we can begin to understand better the situation as it stood on the night of September 18, last year. Now Japan has invested nearly a billion gold dollars in Manchurian railways, mines, industries and other enterprises, all dependent upon law and order, good government, and the prosperity of the country for legitimate returns on the investment.

The gradual impoverishment of the people and the destruction of their purchasing power through flooding the country with billions of worthless notes, had undermined the value of these investments to where returns had reached the vanishing point. What the Chinese war-lord could not accomplish by force of arms in driving Japan out of Manchuria was being brought about by the economic ruin of the country through confiscatory taxation. The Communization of Manchuria would complete Japan's economic ruin in a sphere deemed vital to her existence. This will help to explain why Japan is now determined to support an independent Chinese government in Manchuria that will faithfully discharge its rudimentary obligations to the people under its rule and assume its proper responsibilities for the defense of its territory against the menace from the direction of Urga. For, if Manchuria goes Red, Japan will once more have to fight for her existence on the soil of China.

The Menace of Communism

Aside altogether from the dangerous political crisis arising out of treaty violations and disputes over railways and other matters, the situation was ominous. Events were shaping themselves towards an explosion. There is every reason to believe that had Japan continued her conciliatory diplomacy; had her army refrained from resorting to self-defense on September 18 of last year, the prevailing unrest would have provoked a crisis of another and more dangerous character. The general situation last September was like this. The armies of Nanking and Canton were preparing for another major civil war in South China. The Communists in the Yangtze Valley blocked Nanking from assuming the offensive. They held the balance of power. Civil war in the South might have resulted in the triumph of the Communists. North China was held as a conquered province by the young Manchurian war-lord, who, deprived of his usual huge revenues from Manchuria had appropriated all the revenues of the territory under his sway and was calling upon Nanking for additional funds. Manchuria was seething with discontent. Winter was approaching, with the farmers lacking the means to purchase even the bare necessities of life and comfort. Behind all this stood the Communists in North Manchuria, Siberia and Mongolia with arms, munitions and supplies ready to slip across the border to their Chinese allies. It is true that there remained in Manchuria a Chinese army of some 250,000 men, but the events of 1929 proved that they could not be relied upon to check any forward move on the part of Russia, or suppress any organized internal movement directed by Red agents. The fate of Manchuria hinged on the outcome of events in Central and South China.

The swift action of Japan's army on the night of September 18, stopped the impending war in the south and averted the more serious catastrophe. Events had so shaped themselves that had Japan not resorted to self-defense over the incident at Mukden, another vast region would have been dominated by the Communists and North Manchuria would ultimately have gone the way of Mongolia. The principle of self-determination was sufficient to establish the Independent Republic of Mongolia and bring it under the Soviet system. The same principle would have been applied in Northern Manchuria with equal success. It is a curious paradox that although the Powers and the League are quite willing to acquiesce in any territorial change in the *status quo* brought about by the self-determination of peoples holding Communistic ideas they demand strict adherence to treaties and covenants when other peoples appeal to the same principle to set up an independent state as a defense against communism.

Whether Japan realized the danger of the situation in China, is not for me to say. It is sufficient to point out that she was well within her rights to protect herself while there was yet time to do so, thereby creating a new situation that developed rapidly to the point where the people of Manchuria were enabled to free themselves from the yoke of their military taskmasters, set up their own government and combine with Japan for mutual defense against the menace that looms just over the border; a menace that is both imminent and real; a menace that no other single Power or combination of Powers can protect them against. The life of Japan and the independence of Manchuria were at stake. There are no buffer states or a "Cordon Sanitaire" as there are in Europe to absorb the shock. There is no guarantee of security by treaties or covenants which can stave off the inevitable clash in Eastern Asia. Even if these guarantees existed, in practice they would not be worth the paper they are written on. No foreign army of sufficient strength could be transported to Manchuria in time to be of any assistance to Manchukuo or Japan. There is no international power that can check the slow, steady, relentless onward march of the Bear towards his warm-water goal or thwart the equally grim determination of his Communist masters to dominate Asia and oust the capitalist powers. With the Soviet in Mongolia and North Manchuria; with Chinese Turkestan already part of their economic empire; with Central China converted into a congery of Soviet communities; with a Red army of 250,000 in Eastern Siberia, a Mongol army of nearly 100,000 led by Red officers and with Northern Manchuria seething with discontent; the picture carried its own moral.

Moscow Feverishly Prepares

That however, is only the foreground of the picture. What does Manchukuo see as it looks across its Western border? It sees first the great expanse of Mongolia, once an integral part of China, but now an independent state forming part of the Soviet system of republics and closed to foreign trade, travel and residence. It is known that the Mongols have been organized into armies under Red officials and are now highly drilled and efficient. To the north of Mongolia, in the Baikal region of Siberia, is a special Far Eastern Red Army numbering some 250,000 men based on Irkutsk and Chita, with tanks, motor transport, aircraft and munition bases in the same area. All along the northern Manchurian borders from Chita to Vladivostock are other strategic centers, military bases and garrisons. Manchuria, north, east, and west is hemmed in by Communist armies, the advance guard of the main Red army of a million men in European Russia, ready to move when the preparations for another advance are completed.

These preparations are being feverishly pushed to a rapid completion. The Five Year Plan and its extension provides for extensive railway construction of trunk and feeder lines in Siberia. The Trans-Siberian line has been double-tracked as far as Irkutsk. The Turk-Sib Railway is completed. Branch and feeder lines reaching out towards the Mongolian border are part of the plan. A 1,250,000 ton steel mill is being erected at Kuznetz in the Altais; a new ammunition base in the heart of Central Asia. Another 2,500,000 ton steel mill is going up at Magnitogorsk in the Eastern Urals. Huge tractor, machine and automobile plants are being erected in the same district and are now turning out their products. Non-ferrous mines are being opened; other industries and enterprises are springing up in all the towns of Siberia. There is talk of transferring the Soviet capital from Moscow to the new industrial and strategic center in the Urals. If that is done, Russia will become a formidable, self-contained Asiatic power with huge ammunition plants and other war-industries in a region safe from attack on the part of any other Power. Asia will then lie at the mercy of the Soviet.

Russia lost the war with Japan in 1905 because she fought it at the end of four thousand miles of single track railway and drew her supplies from European Russia. The railway broke down and she was defeated. Russia will not make that same mistake next time. When her plans are carried out, Soviet Russia will be in an impregnable strategic position in Central Asia ready for the next forward move. These plans may be entirely peaceful and legitimate. But we know what has happened to Mongolia; we know what is happening in Central China; we do not forget that Canton allied itself with Moscow to establish its rule over the rest of China; we know that many of the present leaders of China are in close touch with Moscow; we know that the only outlet for the trade and commerce of this vast Siberian empire is somewhere on the Pacific and that Moscow will resort to every means, fair or foul, to obtain that outlet. We have no illusions about the aims and aspirations of the Moscovite, whether he be under an imperial, republican or communist type of government. The goal for a warm water port is always the same. To this must now be added the determination of the Soviet to dominate Asia through the propagation of Communist doctrines.

Manchukuo Isolated and Helpless

This is the menace that Manchukuo and Japan see looming just over the border. Russia is not a member state of the League. She was not invited to attend the Washington Conference and did not sign the Nine-Power Treaty. She did, however, sign the Pact of Paris, but Litvinoff's answer to Secretary Stimson's note of 1929, leaves us in no doubt as to her attitude towards its provisions. Manchukuo and Japan dare not assume that Russia will adhere to the peace pacts. The signatories to the Nine Power Treaty made no protest when Russia amputated Mongolia and incorporated it into her system of Soviet Republics. No help came from that quarter when Russian generals, arms, money and munitions flowed into China to direct the Nationalist movement for the conquest of the country. The outside world hastened to recognize the new government and entered into new treaties with its successor. No help will come for Manchukuo from the Eight Powers when Russia is again ready to move.

There remains the League of Nations. Will the League and the United States guarantee the security of Manchukuo and Japan against the menace from the direction of Urga? Will they dispatch their armies to the Far East when the show-down comes? For ten years or more France has endeavored to wring from her former

Allies a promise of armed support in the event she is attacked. This security is denied to her and as a consequence, France has created her own security and stands ready to protect herself alone, if necessary. The whole dream of world peace and disarmament hinges on the security demanded by France. If the other great Powers will not guarantee the security that France requests, what assurance has Manchukuo or Japan that assistance will be forthcoming when their existence is imperilled ?

Japan stands or falls with Manchukuo. Her back is against the wall. She entertains no illusions about the future and is preparing to defend her existence while there is yet time to do so. Manchukuo entertains no illusions about her ultimate fate, unless she has assurance of help from the outside. The Nanking Government is impotent, fighting for its very life against the communist menace in its own bailiwick. No help will come from that quarter or from Canton. On the contrary, there is every reason to believe that they will join the Soviet or seek its assistance in order to impose their rule upon the people of Manchukuo. We can expect no help from the League or the United States, so Manchukuo has signed a pact for mutual defense with Japan. Refusal on the part of the League or the Powers to recognize this treaty and the independence of Manchukuo simply means that the principles which the League upholds in Europe to safeguard the peace and security of this continent, do not apply in Asia.

Any decision that the League might arrive at, that fails to recognize these principles makes it for all practical political purposes the Ally of Russia in Asia, surrendering and subordinating its principles in order to safeguard the security of Europe. If Japan and Manchukuo are to be penalized for taking the law into their own hands, when there is no law to protect them or means to enforce the law if it did exist, then the League is condemning Manchukuo and Japan to death, for resorting to the higher law of self preservation.

Manchukuo is Not a Second Korea

Japan has declared her intention not to annex Manchuria, that all she is interested in, is to assist in establishing a government that will discharge its functions and promote peace and prosperity. Manchukuo is satisfied with this declaration of intentions. Its government is convinced that Japan means what she says and will live up to her promises. They are told that Manchukuo will go the way of Korea and ultimately become a part of the Japanese Empire. But the people of Manchukuo know that Japan will never attempt to bite off and swallow something she cannot digest. They know that Korea has cost Japan over a billion gold yen since its annexation and she has received in return on this investment only an additional security.

Those who know the inside story of Korea's annexation, realize that Japan had no choice in the matter. It was forced upon her by the stern logic of events. She faced the same menace in 1910 that she faces to-day. At that time Russia, who by the 1896 secret treaty of alliance with China had obtained a free hand in Manchuria, was feverishly pushing ahead her plans and preparations for a war of revenge, that Count Witte in his Memoirs confesses was scheduled to take place in 1912. Japan was forced to keep pace with these preparations for her undoing ; to increase her armies year by year and consolidate her land position by bringing Korea within her strategic sphere. She dared not leave this frontier exposed to another Russian advance.

The Government of Manchukuo are aware of this precedent and, faced with the same menace, are willing to co-operate with Japan in mutual defense. They are not afraid that Japan will swallow Manchukuo. If the precedent of Korea is any criterion for the future, Manchukuo is more likely to swallow Japan.

The Basic Population Problem

Let me explain this, as in what I have to say about Korea will enlighten you to the basic problem of the Far East. When Japan went into Korea in 1906, she gave the people good government, law and order, sound currency, low taxation and a release from the oppression of their native rulers. Japan built railways and highways, hospitals and waterworks, she installed sewers and enforced hygiene and inoculation ; there were no wars, floods or famines ; what happened ?

In 1906 when Japan took over control there were 9,000,000 Koreans. In 1929 there were 19,000,000 Koreans, with another million that had migrated to Manchuria and another million that had found an outlet in Japan proper. The Koreans doubled their numbers in about 22 years, or seven times as rapidly as the white man. Here we have an example of what the human race is capable of doing in reproducing itself ; one generation pressing hard upon the other. Now we are told that Japan is a hard taskmaster, that the Koreans are a much abused and oppressed people clamoring for their independence or a return to the old conditions. Well, all I have to say is that any people who can double their numbers in twenty-two years must be living under a most beneficent government.—— look at India !.

We are told that the Japanese are forcing the Koreans out of their own country in order to take over their lands and that this policy is forcing the Koreans over the border into Manchuria to serve as the vanguard for Japanese imperialism and to justify further aggression. The population figures clearly prove that this movement is simply the pressure of a rapidly multiplying people from within that is forcing the Koreans over the borders in their struggle to survive. It is not alone to Manchuria that these people are going, but they are emigrating to Japan and taking away the work from the people of that country. Korea offers no solution to Japan's population problem. On the contrary, the picture shows that Japan is becoming the outlet for an over-populated Korea. In these few figures you will gather some idea of the basic problem of Eastern Asia, the operation of tremendous human forces which no laws or treaties can regulate or control. Here you see the full effect of the Oriental conception of life and morality on the birth-rate ; a civilization based on ancestor worship having as the basis of its creed the necessity of having as many male children as possible to perpetuate the cult. The procreative recklessness of these people constitutes a problem that will force itself on the rest of the world before many decades are passed. That issue is inescapable. Whether or not the issue will be settled in the Pacific or on the plains of Central Asia, hinges entirely on the attitude of the League and the United States towards the present dispute over Manchuria.

If the Government of the United States invites unto itself the settlement of this issue in the Pacific, then it is no time to talk of disarmament. If I disagree with the policy of my own government on these questions, it is because I see no good reason why the young manhood of America should be called upon to sacrifice themselves in a war in the Pacific for the sake of five hundred million sturdy pacifists who will not fight for themselves and whose disorganization invites the conflict. The problem of the races in Asia should be settled in Asia. It is none of our business. If we are wise, we will assist Japan in seeking her outlet in Manchuria and Mongolia and, when the racial issue comes up for final settlement, the fight for supremacy between the Mongol and the Slav will be fought out on the plains of Central Asia, where it belongs. Any diplomacy, any decision of the League that would divert the solution of this problem into other channels, can only result in disaster to nations who have no direct interest in the result.

What Japan Gains in Manchuria

What Japan did in Korea, she will do in Manchuria. She will help to organize and maintain an efficient government. With her assistance the new government will bring peace, law and order, security and prosperity to the people of these regions and in twenty-five years there will be 60,000,000 Manchurians. Just as soon as the bandits are suppressed, the old worthless notes replaced with sound currency and there is a little prosperity, the Government of Manchukuo will be compelled to enact stringent immigration laws to keep from being inundated by the flood of people from North China seeking an escape from their misery. So they are not worried about Japan. All she can hope to get out of her friendly co-operation with Manchukuo is a strengthening of her strategical security through the erection of a strong buffer state for mutual defense against a mutual menace ; an obligation that the old régime was either too weak or unwilling to discharge. In addition, Japan will enjoy an assured source of necessary raw materials and food supplies and near-by market for her manufactured products on equal terms with other nations. Manchukuo has nothing to fear from Japan. She has nothing to lose by seeking her friendship and co-operation ; on the contrary, she has everything to gain.

Manchukuo Not a Puppet State

Manchukuo is a Chinese state. It is not a protectorate, a dependency or a puppet of Japan and never will be. If Japan's problems are to be solved in Manchukuo, it stands to reason that she will go down to defeat if she fails to convince these people of her friendly intentions. Any attempt on Japan's part to impose her will in the internal affairs of Manchukuo, or for the Japanese to set themselves up as conquerors or superiors, will provoke resentment and hostility.

Manchukuo stands on a basis of full equality with Japan, accepting merely such initial help and guidance as will enable it to establish itself firmly and discharge its internal functions and international obligations. The Government of Manchukuo, composed as it is of intelligent Chinese, resent the imputation that they are puppets of Japan ; that in some way or other they are bound by treaties or covenants to accept some war-lord of southern China as their sovereign. The Government of Manchukuo rejects the theory that the League or any outside Power has the right to determine who shall rule over them. They refuse to place themselves under a Government that has never been able to conquer them and for which they entertain a supreme contempt.

How Independence Came to Manchukuo

The Government of Manchukuo takes exception to the conclusions of the report of the League Mission that they do not represent the will of the people and retort that as far as humanly possible under a system where there is no machinery for registering the popular will, they come nearer to being a representative government than any of the military and bandit régimes that have been set up in China and recognized by the Powers as the Government of a Republic. They have a better right to rule in the name of the people than the régime that kept them in slavery for the past two decades at the point of the bayonet. It is sheer folly and contrary to human nature for a foreign mission of enquiry to assume that the people of Manchukuo were contented with their lot. They were not. Many plots and schemes for overthrowing the bandit oligarchy were concocted but all attempts at uprising proved abortive owing to the presence of 400,000 armed men in the province. Backed with an arsenal that cost $100,000,000 gold wrung from the toil of the people, and with all the wealth of the province in the strong boxes of their overlords, how could the people of Manchuria finance or stage a revolt with any hope of success ? Not until the Japanese dispersed this army did the opportunity present itself to the people of Manchukuo to assert their rights.

Now, the army is the sole government in China. When these armies are defeated or dispersed, the government collapses and a reign of lawlessness, of looting, rapine and murder is ushered in. That is exactly what happened in Manchuria last year. When the armies of Chang Hsueh-liang were dispersed in Mukden, the civil officials fled to Peking to escape the wrath and vengeance of the people they had plundered. A complete collapse of Government ensued, a vacuum was created that had to be filled at once in order to preserve law and order. The Japanese could not establish their own régime. They had no prearranged plan for annexing or interfering with the government of the country. It was difficult for the first few weeks to induce competent Chinese to assume the responsibilities of government. They were extremely loath to come forward, fearing that if Chang Hsueh-liang returned to power, their heads would be forfeit. It was not until the Japanese assured them that the Young Marshal would never be permitted to return to Manchuria with his armies, did these Chinese dare to come out into the open and occupy posts of responsibility. I can not tire you with all the details leading up to the organization of the new state, but it is sufficient to point out that as far as possible the new government represents the will of the people expressed through the guilds, Chambers of Commerce and other associations whose delegates assembled at Mukden and organized the present Government.

This is the only machinery for ascertaining the will of the people of China and until the people are educated to some idea of their duties and responsibilities as citizens, and a real election can be held, this machinery will continue to be the only means of registering the popular will. The only way, for the present, to ascertain the wishes of the great masses of illiterate and inarticulate Chinese is to cater to their material needs, provide them with the opportunity to work and assure to them the proceeds of their toil. Then, and only then, can we hope to obtain the approval of these people to any government. As for Manchukuo, its 30,000,000 farmers are now permitted to bring their crops into the open market and receive in payment real money that can be exchanged for the necessities of life. A new era has opened for these submerged millions. For the first time they are glimpsing ahead a new future, one full of hope and prosperity. They stand on their feet as free human beings, and as this sense of freedom is more and more brought home to them, they will fight to preserve their independence. Do you believe that 30,000,000 human beings, facing such a future as free men, are willing to return to their old condition of slavery ? Is it conceivable that the people of Manchukuo will now accept a ruler appointed by Nanking in order to appease some outside nations that are displeased with the manner in which they gained their independence ?

A Heaven-Sent Opportunity

The people of Manchukuo are not interested in what other people think of the methods by which they achieved their independence. They seized the only opportunity whereby that independence could be achieved. For them, the end justifies the means. Whether this opportunity came as the result of Japan's resort to self-defense or whether it came as an Act of God, it was all the same to them. Heaven heard their prayers and intervened to save them. The long-hoped-for opportunity when it came was seized upon by a long suffering, patient, helpless and inarticulate people as the only way out of their bondage and misery. Who will challenge their right to this independence ? Who will take it away and hand them back to the ruthless and intolerable rule of the Chinese war-lords ?

Again, I emphasize that Manchukuo is a Chinese state. In their great majority, the people are Chinese in heart, in culture, in civilization and traditions, bound by ties of race and family to their brothers south of the Wall but separated from them by political differences. In the main, these people have settled in Manchuria in order to escape the intolerable conditions under which they lived in other parts of China. They owe nothing to Nanking, to Peking or to Canton. They have no quarrel with their brothers south of the Wall. They simply do not wish to become embroiled in their endless civil wars and are determined to seek a solution to their own problem in their own way, free from interference on the part of the war-lords. They are fed-up with civil war and the attempt of the Kuomintang minority to set up its dictatorship by the sword. They recall that the Cantonese leaders entered into an alliance with Moscow in order to impose their rule over the whole country and the result has been chaos, anarchy and the spread of communism to the point where it now threatens the very life of the Nanking Government.

Manchukuo does not intend to accept these doctrines, and is opposed to the methods employed in forcing them upon the country. The people of Manchukuo have accepted Japan's assistance in setting up a government that will adhere to the traditions of the race, a Chinese Government that the people understand and will obey. However, if at some time in the future, the rest of China becomes united under a strong representative government of, by and for the people, the people of Manchukuo will undoubtedly seriously consider a proposition to unite with them on some basis of full equality, in a federation of sovereign states. This cannot be forced upon them at present. It is a possibility that can be realized only when the rest of China proves worthy of such association.

Dissolution of China

We are told that China is passing through a period of transition ; that we are witnessing the evolution of a people from medievalism to modern democracy. The evidence, even in the Lytton Report, points to a rapid dissolution into several independent states, the recognition of a reality that has existed for many years. The unity of China is a diplomatic fiction. The recognized Government of the Republic of China exerts no authority outside the three provinces of Kiangsu, Chekiang and Anhwei. If recognition of the powers were withdrawn, this government would collapse like a house of cards. Even now it is fighting for its very life in the Yangtze Valley against the Communist armies which dominate large areas of this region and the outlook for suppressing this menace is far from bright. Every cent of the revenues derived from the trade of

Shanghai goes to pay for the upkeep of the Nanking armies and the cost of these wars. No development, no reorganization, no progress is possible as long as these conditions endure. The slaughter will go on, in the hopeless attempt to subjugate the people of China to the will of the Kuomintang minority. Here again, we have a curious paradox in the working of the League. Even the Report of the Mission of Inquiry seems to have ignored it. One of the chief obligations of the League in Europe is to protect the religious and racial minorities from injustice and persecution by the majorities, but in China it is the majority that clamors for protection against the armed minorities. Three million soldiers and two million armed bandits are holding in subjection 495,000,000 unarmed peasants and workers who have no voice in the conduct of their own affairs. Here again, it is only a step across the dividing line which separates the Communist system from that of the war-lords and the Kuomintang dictatorship in China. There can be no peace, no justice, no progress, as long as these conditions are permitted to exist.

China, a Menace to World Peace

The Report of the League Mission of Inquiry very accurately and faithfully describes the chaos and anarchy reigning in China and points out that until these conditions are remedied, China will continue to be a menace to world peace and a contributory cause of world economic depression. It also makes clear that the present inadequate means of communication in China is a serious handicap to the establishment of strong central government and unless communications are sufficient to ensure prompt transportation of national forces, the safeguarding of law and order and the exercise of authority is practically impossible. The report goes on to suggest that international co-operation is the solution to China's problems, but it fails to indicate how this international co-operation can be applied. To those who understand the problem, the suggestion leaves us just where we have been for the last twenty years. No solution of these problems is possible without the immediate construction of a system of at least ten thousand miles of necessary trunk railways and feeders that will enable the government to consolidate its authority. This will cost half a billion gold dollars. Who will furnish the loans for this construction ? Who will guarantee the bondholders ? China has no assets to secure these loans. Will the League of Nations guarantee them ? What does that guarantee amount to ?

The Chinese delegate to the League, Dr. Wellington Koo informs us through the press, that China abides by the Report of the League Mission and is willing to accept its suggestions as a solution to the dispute with Japan. Manchukuo is willing to co-operate with the League in making the reorganization of China proper a success, but stands on its independence and declines to admit any outside interference in its own affairs.

Manchukuo has declared its independence because of these very conditions that the Report holds as a menace to world peace. There is menace also to world peace in the situation which Manchukuo has to face in the North, a menace that the League or China Proper have paid no attention to in the past and which now cannot be longer ignored. The great task of the League is to reorganize China. It is the hope and wish of Manchukuo that the League will assume this responsibility and, when the time comes when the country is united under a government truly representative of the people, when the armies are disbanded and there is an assurance of justice and equality, some guarantee that the national army will defend the nation against outside aggression from all quarters, then the people of Manchukuo will give very serious consideration to a proposal for co-operating with China under some equitable agreement for the preservation of peace and defense of mutual interests.

Manchukuo's Right to Seek Outside Help

The League Report says, in effect, that Manchuria is an integral part of China. It says that it cannot recognize the independence of Manchukuo. It encourages Chang Hsueh-liang or Chiang-Kai-shek to believe that they can send their armies and re-establish their rule over the people of Manchukuo. All perfectly legal and within the treaties. But, let me remind you that the reverse is equally true. If the armies of the war-lords invade Manchukuo or insist upon using North China as a base from which to menace its independence, there is nothing to prevent a Manchukuo army from invading North China and capturing Peking. That is also perfectly legal and within the treaties. If the League and Powers refuse to recognize the independence of Manchukuo, then the internal situation of China remains in *status quo* and these wars will go on until one side or the other imposes its rule by the sword. If Manchukuo should emerge victorious from such a war, it would be no concern of the outside Powers. It would still be simply a domestic squabble in which they have no right to interfere.

Even if the Manchukuo army was led by Japanese officers and supplied with arms and munitions from Japan ; what of that ? How did the present government at Nanking get into power ? Were not the Cantonese armies directed by Communist leaders ? Were they not financed in part from Moscow and supplied from the same quarters with arms and munitions ? Has Manchukuo the same rights to enter into an agreement with Japan ? If one part of China can call upon Moscow for assistance in enforcing its rule over the rest of the country, surely another part of China has the same right to call upon another power for assistance in a sphere where the interests of the power are deemed vital to its existence ?

Manchukuo Wants Peace

Now the people of Manchukuo do not want to fight their brothers in China. They have no intention of invading the country south of the Wall. They want peace. They want a chance to live their own lives in their own way. They are not worrying about being swallowed up by Japan. Japan has not conquered Manchukuo. She will never dominate the country. The people of Manchukuo will see to that. China has co-operated with Moscow in the endeavor to establish a strong government and the result is before us ; a menace to world peace. Manchukuo is willing to try the experiment with Japan and feels assured that once law and order is established and the bandits suppressed, their country will go ahead by leaps and bounds on the road to a real prosperity that will set an example for the rest of China to follow. Nanking is willing to accept international co-operation to reach the same goal. Manchukuo accepts the co-operation of Japan simply because their interests are identical and there is a better chance of surmounting their difficulties by working together in a close harmony.

I would like to tell you something about the progress already made by Manchukuo, but it would take too long. We are steadily forging ahead and improving our financial position and increasing our trade. We are making progress and see ahead a real prosperity. All Manchukuo asks is to be let alone for a while. Don't condemn or prejudge the new state before it has a chance to show what it can do. The world has answered the appeal of Nanking to give it time, and the conditions in China grow steadily worse.

The Government of Manchukuo is certain that it can show real results in a year or so. If the League and the Powers do not care to recognize it, at least give it the benefit of the doubt. Remember that Manchukuo is a Chinese state. Its understanding with Japan is of the same order as the one which Canton entered into with Moscow. Yet the Powers made no protest and recognized the Government established as the result of that alliance. Manchukuo is entitled to the same consideration. Again, I emphasize that the people of Manchukuo hold no grievance against the people of China Proper. They want to live in peace with their brothers and ask only an opportunity to show what they do. They stand on their independence and are determined to assert it and, if needs be, to fight to maintain it. The peace and future of the Far East, the peace of the world may hinge on whether or not the people of Manchukuo are permitted to exercise this right of self-determination. If they are not, then the future is dark indeed.

Ni-Tao-Na-Li-Ch'ü

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What Price Postal Bans—Boycotts—Warfare?

By C. J. LAVAL

TOWARD the end of December when the governing body, or the Central Executive Committee of the Kuomintang, held its third Plenary Session at Nanking the public in China, and in Japan as well, was electrified and some portion of the rest of the world was astonished in consequence of a report from Nanking. It was announced that a group of prominent leaders of the Government had moved to cut the nation adrift from Occidental influences and send the ill-conditioned Chinese Ship of State adventuring into strange and dangerous waters. The action which was proposed in the form of a resolution to make war in the north and to sanctify the boycott against Japan, also carries a rebuke for the League of Nations and sounds a note of chagrin over the failure of the leading powers, particularly the United States, to adopt some positive course with regard to the controversy in Manchuria. Those who signed the resolution seem to have had brought home to them at length the bitter realization that the western powers, harassed with their own preoccupations—war debts, mass unemployment and stagnant commerce—and, possibly also, not so sympathetic as had been expected, will do and can do nothing for China in this troubled hour.

About this same time, on December 19 to be precise, government authorities at Nanking decided arbitrarily, without warning, to cancel the postal registration of *The Far Eastern Review* and to bar the magazine from the mails in China. The adoption of the resolution by the Central Executive Committee at Nanking, although this is supposed to be a secret, is a matter of major consequence, actually touching the well-being of the Chinese State. The imposition of a postal ban upon *The Far Eastern Review* affects and penalizes a single American institution, and in the march of national events this cannot be seen otherwise than as a venial offense. But the two things, the greater and the lesser, have a common quality, for both illustrate again vividly the fatal and consistent genius of Chinese leaders to do the wrong thing, and this unerring racial characteristic affords as good a cause as any for the plight in which China finds herself to-day.

In all the world-spread welter of written and oral thought about Chinese affairs in the past twenty years—a world of books and a universe of words—with scholars, missionaries, statesmen, diplomats, politicians, pacifists, pedagogues and plain fakirs making a mighty chorus, one voice consistently through the years has rung true for the weal of the forgotten people of China, that incalculable inarticulate ethnic bloc, outraged and enslaved, that has never heard of and could not understand the meaning of such words as "extraterritoriality" and "unequal treaties." That voice has found outlet in the columns of *The Far Eastern Review* in the writings of the American citizen, George Bronson Rea, who in his times has been more signally honored than any other foreigner by the greatest patriot and leader China has produced in contemporary years.

The imposition of a postal ban on *The Far Eastern Review* by the present-day politicos at Nanking obviously is without a shadow of legality, an action that is a cynical repudiation of all the unctuous assurances given at Washington in 1922 when the foreign powers surrendered to the Chinese authorities complete control of postal services in China. The writer looks back on something more than a decade of effort in the uneasy post of editor of foreign newspapers in China and so modestly may claim a measure of understanding of the causes and consequences of postal bans and like manifestations. In a recently published and widely discussed work by the noted British authority, Mr. J. O. P. Bland,* the position of the press in Chin a is ably described. He says:

> "Since the beginning of the twentieth century, such knowledge as the eighteenth and nineteenth

A Message from Home

"The American Friends Service Committee, representing the Society of Friends (Quakers) in America, is deeply concerned over the terrible burden of suffering now resting upon the people of Japan and the people of China. We are conscious that we of the United States must bear our share of responsibility for the world-wide history of injustice, exploitation and conflict that has brought misery to those of all lands. In common with increasing groups throughout the world we believe that the time has come in the evolution of mankind when international difficulties, however grave, can be adjusted by conciliation and co-operation.

"Military action, boycotts, economic reprisals, and other extreme forms of coercion between nations, threaten the very existence of modern civilization. We would constantly bear in mind that this civilization is founded upon an intricate and delicate adjustment of the inter-dependent life of all peoples. In the modern exchange of merchandise, of credit, of knowledge, of hopes and fears from one continent to another, the well-being of every people is inseparably linked with the common life of all.

"The deep suffering in body and in soul which is now shared by millions of persons everywhere, is the product of the antagonisms that have interrupted this flow of co-operative enterprise. In rejecting the use of force and coercion in dealing with these antagonisms we are not left without an effective alternative. We believe that the spirit of persuasion, conciliation, and mutual understanding is the only power that is adequate for the solution of international conflicts. In reliance upon this power man allies himself with those spiritual forces that make this world a united family and give men courage to live on through seeming disaster. We dare to believe that this spirit of good-will is present in all men in every land.

"It is our conviction, born of intuition and confirmed by experience, that man is essentially a co-operative rather than a combative creature, and that the history of civilization is the record of the growth in ever-widening circles of the spirit and method of co-operation. This process has resulted in our time in a world community, in which a growing sense of economic inter-dependence and spiritual unity has found expression through such political forms as the League of Nations, the Pact of Paris, and the Nine Power Treaty.

"In the present Sino-Japanese conflict we believe, specifically, that the type of procedure envisaged in Article 19 of the Covenant of the League of Nations, which make possible 'the consideration of international conditions whose continuance might endanger the peace of the world,' offers a way out. Utilizing the spirit and machinery of this article, which provides for conference, without coercive sanctions, representatives of all interested nations, including the United States, could join in a friendly discussion and settlement of the issues involved. In solemn realization of the gravity of this situation, we would join in spiritual fellowship with men and women in all countries who will lend their influence to such a method of solution.

"There is more at stake than the well-being of the peoples of the Far East. There is involved the peace of the world, the relief of vast human misery, the maintenance of co-operative agencies already achieved, and the fresh release of mutual confidence which alone can mend the torn fabric of our common life.

"We appeal particularly to those men in positions of power in all lands to make themselves the courageous instruments of this high endeavor."

*"China The Pity of It," Heinemann, London.

possessed, has gradually been rendered more obscure, and educated opinion increasingly confused, by reason of the propaganda, skilfully devised and widely distributed abroad by the agents of the Kuomintang, whereby a completely misleading idea of Chinese affairs has been created and successfully maintained. And side by side with this intensive *suggestio falsi*, there has been developed, since the southern 'Nationalists' overcame their northern rivals and removed the capital to Nanking, a deliberate policy of *suppressio veri*, which has not only deprived the vernacular press of the last vestiges of freedom but, emboldened by impunity, has established an effectively coercive censorship over the writings of foreign authors and journalists resident in China. With the rare exceptions, therefore, of works from time to time published by the few writers who combine accurate knowledge and sound judgment with personal independence, most of the materials which have gone to the making of opinion abroad have been either inspired or approved by the Kuomintang authorities. The foreign press, at the Treaty Ports in particular, has in recent years been so forcibly convinced of the pains and penalties of plain speaking, that its utterances have become acquiescent to the point of deference and its attitude towards the powers that be is pathetically eloquent of the insistence with which the policy of patient conciliation has been enjoined upon them from Westminster and Washington. No newspaper, conducted as a business enterprise, can afford serious criticism of an oligarchy which does not hesitate to withdraw postal, telegraphic and transport facilities from those who venture to hold it up to censure."

George Bronson Rea's Position

George Bronson Rea long has been an outstanding authority on Far Eastern affairs. He was offered and accepted the position of Counsellor to the Ministry of Foreign Affairs of the newly formed Government of Manchukuo. It may be recorded here properly that assent to this appointment was given in high places. Before he appeared at Geneva George Bronson Rea conversed with the President of the United States, Herbert Hoover, and George Bronson Rea is a loyal patriotic American. The task that he has undertaken is fraught with difficulties, and with peril, but it bears no relationship to the engineering journal, *The Far Eastern Review* which George Bronson Rea happens to own. To his task he takes a mentality alert and well-stored with the study and rich experiences of many years' life in the Far East. And to complete the picture it should be added also that he possesses to a high degree— borrowing a phrase from the current lexicon of the American undergraduate—intestinal fortitude. He has proceeded, therefore, about his affairs and, assuredly, he is serving and he will serve his client to the peak of his ability. If all attorneys were to be penalized for the faults ascribed to their clients we should arrive swiftly at something approximating the dearest dreams of Emma Goldman and Vladimir Lenin.

The Far Eastern Review in the far-flung influences it enjoys all over the world has grown through the twenty-eight years of its existence beyond the scope of any single individual or of any one country. This magazine has witnessed unhappily the appearance and disappearance of succeeding régimes in the vexed land of Cathay, and it has persisted in its work somewhat longer than the span of years that measure the life of the Chinese Republic. It may be expected reasonably, therefore, that it will be surviving when its unkind friends of this day at Nanking have passed on to other occasions.

Of greater moment far, to China and to the world at large than Nanking's side-thrust at *The Far Eastern Review*, is the new line of Chinese policy envisaged under the terms of the so-called "resolution of defiance." One element that made this measure momentous and sensational was the list of signatures it bore when it originally was made public. Here the reader found a fine commingling of prominent representatives of both the Canton régime and the Nanking régime, and at the head of the group stood the name of no less personage than that of the Minister of Finance, Mr. T. V. Soong, while the name of the Commander-in-Chief of all China's armed forces was omitted altogether. The resolution as first published was disavowed by Nanking within twenty-four hours. It was explained that the measure, in fact, had been presented, but it was asserted that the seven names originally given as the subscribers were incorrect and that these individuals had not signed, but merely had accepted the resolution and had admitted it to a place in the agenda of the Plenary Session. Thus, it was explained, the Minister of Finance and his six associates were only indirectly and in a secondary manner sponsors of the measure whose actual proposers were not disclosed.

The resolution, aside from its plain implications, presents an interesting quirk of Chinese politics, for in the particular association of names as first set forth it seemed that ancient enmities, as has happened so often before, were being glossed over in the formation of new and arresting alignments. Listed with the Minister of Finance in the original report were those Cantonese stalwarts, Sun Fo, the son of Dr. Sun Yat-sen, and Dr. C. C. Wu, former Minister to the United States, and son of that other famous former Minister to the United States, the late Dr. Wu Ting-fang. In the group also appeared the name of General Wu Teh-chen, Mayor of Greater Shanghai, who hypnotized young Marshal Chang Hsueh-liang into amiability two and a half years ago on behalf of Chiang Kai-shek and Nanking and induced the Young Marshal, then the undisputed overlord of all Manchuria, to cast in his lot with the Nanking Government and to move his troops inside the Great Wall, enabling Nanking in the summer of 1930 to conquer the Northern Coalition of Feng Yu-hsiang and the Shansi overlord, Yen Hsi-shan. It was that fateful intervention which ultimately took Chang Hsueh-liang out of Mukden and into Peiping, and, assuredly, when he made this move he little dreamed that he would not again return to his northern stronghold. The others in the list of signers as first given include the Minister of Industry, Chen Kung-po; the former Commander-in-Chief of the Chinese Air Forces, Chang Hui-chang, and the former Commander-in-Chief of the Canton Navy, Admiral Chen Chek.

The program of action proposed in the resolution is as follows:

(1) That Chinese troops should be concentrated in the Jehol, Chahar and Hopei areas with instructions to resist if "enemy troops" invade Chinese territory; and, if an opportunity arises, to enter Manchuria in an attempt to recover the "lost territory."
(2) That both the Kuomintang and the Government should afford the utmost assistance, both spiritual and material, to the Manchurian troops and Volunteers in Manchuria, and
(3) That the Kuomintang and the Government should direct the entire nation in a boycott of "enemy goods."

Back from Moscow

It is understandable why this measure, carrying any form of sponsorship of the Minister of Finance, and following on the heels of the recognition of the Russian Soviet Government by the Nanking Government, should cause a sensation and create anxieties. Recognition of Soviet Russia by China is one of the anomalies of the times in a country bereft; it is one of the lunacies of a mad age. Through many years tortured China has been pouring forth floods of wealth to crush and extirpate from the land the one thing that Soviet Russia stands for in this world. What may be the ultimate consequences of the renewed merging of Chinese and Russian interests may well bestir the concern of statesmen of the world. In 1923 when Dr. Sun Yat-sen turned to Soviet Russia for assistance the Chinese leader told the writer of these lines that he had adopted this course reluctantly and with distrust in his soul, and he did this, he said, only after he had been turned away empty handed by Great Britain and the United States, to both of whom he had addressed appeals to help China. This feeling is reflected in the statement he issued with the Russian Ambassador, Adolph Joffe, saying that he held "that the Communistic order, or even the Soviet system, cannot actually be introduced into China, because there do not exist here the conditions for the successful establishment of either Communism or Sovietism." What has happened lies in the record of history and in the hundreds of thousands of graves on the plains of Central China.

It is logical at least to believe that when the Soviet Embassy and the Soviet consulates re-open in China then will begin again the "boring-in" process, the inoculation of the weakened body of the nation with malignant "cells," the claque of mercenary agitators, and the slogan-crying of deluded youths taught by the western world to hate the foreigner. Follows then paralysis of industry, strikes, riots, commotion—chaos. Those who dwell in China have seen this enacted. When Michael Borodin and General Galen, or their prototypes, come back to China let the Kuomintang

look to itself, for then the annihilation of the Party and its Government and all they stand for, and the end of other institutions are to be visioned. An Oriental conception of communism may fasten itself upon the country and when the exceedingly thin crust of native intellectuality at length is shattered and the uncounted hordes burst forth from the abyss of ignorance, then half of the world may well revert to savagery with every likelihood that the other half will be engulfed. The League of Nations has turned its face to the Far East too late !

The effects of Nanking's new policy are to be seen in the renewed strife and carnage in the north where hapless thousands are being sent to their deaths merely to produce an illusion and to impress the western powers and the League of Nations, for no one can believe or does believe that Chinese arms can prevail in the existing emergency. But the course of military action, in the face of every adverse obstacle, appears to have authoritative sanction. It is superfluous to attempt to detail the inhibitions of money, men and circumstances. The course of warfare for China in the face of existing conditions, and when other methods might be tried is a course that is not to be distinguished from madness.

What Boycotts Mean to China

In the third item of the plan of action brought forward at Nanking China's ancient economic weapon, the boycott, is again brought into play, but with a new and significant emphasis in that by the terms of the resolution the boycott will be given the undisguised support and direction of the Government. Precisely how the boycott is to be regarded in international usage as a weapon of aggression or defense has never yet been defined. This is a problem that may well be left to the parliamentarians at Geneva where sooner or later some authoritative expression must be given in answer to repeated questions. The practicalities of the boycott, however, may be nicely dissected on its native heath in China, for here a vast experience with this device has accumulated.

China has had twelve boycotts since 1905 and eight of these have been staged in the past twenty years since the Revolution. Like the postal ban, the boycott is a double-edged weapon. The plain record of the past reveals that while it is true that boycotts do harm to the trade of countries against which they are imposed and prove a sore embarrassment to individual interests, the harm done to the adversary, far from crippling, ultimately is found to be negligible, while as great or a greater injury is inflicted upon Chinese commerce and Chinese workers. Japan has been the chief sufferer from Chinese boycotts and it may be interesting to study the effects of seven boycotts directed against Japan in recent years. To do this the more fairly utterances of a competent Chinese spokesman may be heard. In a frank address before the Rotary Club at Tientsin recently Mr. M. T. Tsao, of the Continental Bank, Ltd., said :

> " The principal object in declaring boycotts is to reduce the trade of Japan with us to such a degree so as materially to hurt her or so as to paralyze her industries in order that either her Government will realize the folly of her action, or her merchants and industrialists will put pressure to bear upon their Government to ease the demands or impositions to be brought against us.
>
> " We shall now examine the trade effect of these boycotts against Japan. I have taken the figures from a table prepared by Dr. H. J. Huang in his speech on January 15, given in Tsing Hua College. I have also examined the tables prepared by Dr. John E. Orchard in his book entitled 'Japan's Economic Position,' and while his figures do not agree exactly with Dr. Huang's, still they are close enough to satisfy our purposes.
>
> " We find that the volume of trading in 1908 decreased Y.30,404,678 as compared with 1907, but increased Y.10,000,000 in 1909 as compared with 1908. Comparing the figures further during a boycott year with the previous normal year we find that in 1915 there was a decrease of Y.21,248,000, in 1919 an increase of Y.87,899,000, in 1920 a decrease of Y.36,779,000, in 1921 a decrease of Y.123,043,000, in 1923 a decrease of Y.61,330,000, in 1925 an increase of Y.120,040,000, in 1927 a decrease of Y.87,057,000, in 1928 an increase Y.38,337,000, and in 1929 a decrease of Y.26,489,000.
>
> " The increases or reduction in the volume of trade become much less significant, however, when they are compared with the total percentage of Japan's entire export trade during these periods. We see that in 1915 the decrease was 2.9%, in 1919 the increase was 4.1%, in 1920 the decrease was 1.8%, in 1921 the decrease was 9.8%, in 1923 the decrease was 4.2%, in 1925 the increase was 5.2%, in 1927 the decrease was 4.3%, in 1928 the increase was 1.9%, and in 1929 the decrease was 1.2%. We see then the largest decrease was 9.8%. But when we see that the volume of Japan's exports to us during 1914 was Y.162,370,000, and increased to Y.344,652,000 in 1929, we cannot further go on with the belief that boycotts were producing appreciable results economically, and therefore it is safe to assume, much less politically."

What Warfare in China Means

In the course of this same address the speaker was moved to explain that " since the first boycott our different military leaders have gathered huge groups of men in uniform with out-of-date rifles and guns, going about exterminating each other. We wage wars against the so-called communists when we know that with a government which can permit people to live and work peacefully these elements will voluntarily disappear ; that by fighting them by arms simply creates or aggravates the causes for unrest and rebellion. But to fight for our land or for our national honor against a foreign aggressor—the thought is foolish. The attempt is foolhardy, and too risky."

To the foregoing the speaker added pertinently :

> " One other object of the boycott is to protest against the weakness or corruption of our officials. I think our accomplishment in this direction is a naked zero. To-day the most deplorable state is that officials who want to do their work conscientiously and honestly will usually find themselves blocked, or even out of a position in short order. Surrounded with destructive forces, even the ones highest in the authority, with the best intentions to unite the country and to develop her industrially, find the task very difficult and the obstacles hard to surmount. Our politicians habitually dream the hallucinations of an opium smoker, and sing the sweet songs of lullabies. We hear evasive words, irresponsible words and philosophical words. We catch slogans after slogans. We hear there are complete plans to do this and to do that. But these are as far as the work of our politicians go."

Year	*Total Exports of Japan Yen*	*Japan's Export to China Yen*	*%*	*Increase or Decrease from Previous Year*	*%*
1914	591,101,000	162,370,000	27.4		
1915	708,306,000	141,122,000	19.9	— 21,248,000	—2.9
1918	1,962,100,000	359,150,000	18.3		
1919	2,098,872,000	447,049,000	21.2	+ 87,899,000	+4.1
1920	1,948,394,000	410,270,000	20.6	— 36,779,000	—1.8
1921	1,252,837,000	287,227,000	22.9	—123,043,000	—9.8
1922	1,637,451,000	333,520,000	0.3	+ 46,293,000	+2.8
1923	1,447,750,000	272,190,000	18.8	— 61,330,000	—4.2
1924	1,807,034,000	348,398,000	19.2	+ 76,208,000	+4.2
1925	2,305,389,000	468,438,000	20.3	+ 20,040,000	+5.2
1926	2,044,727,000	421,861,000	20.6	— 46,577,000	—2.2
1927	1,997,317,000	334,804,000	16.8	— 87,057,000	—4.3
1928	1,971,955,000	373,141,000	18.9	+ 38,337,000	+1.9
1929	2,148,618,000	344,652,000	16.1	— 26,489,000	—1.2

* From—Dr. H. J. Huang's Speech on January 15, 1932, in the *Tsing Hua College Gazette.*

Boycott Periods		*Value in $ Gold*	*% of Export to China*	*% of Total Japanese Exports*
April-Dec.	1908	—13,332,000	—26.9	— 7.05
Jan.-June	1915	—17,900,000	—29.0	— 5.05
May-Dec.	1919	+32,385,000	+17.0	+ 3.1
Jan.-Dec.	1920	—29,152,000	— 8.9	— 3.0
Jan.-Dec.	1921	—86,961,000	—29.0	—13.9
April-Dec.	1923	—34,498,500	—19.0	— 4.8
June-Dec.	1927	— 2,735,000	— 1.8	— 0.3
Jan.-Dec.	1928	—17,453,000	— 3.0	— 1.8
Jan.-June	1929	—19,137,000	—14.5	— 1.8

As 1927, 1928 were boycott years, comparison for the boycott periods in 1928 and 1929 is made with normal year 1926. From—Dr. John E. Orchard—*Japan's Economic Position,* p. 472.

An Incomplete Picture

The foregoing matter anent boycotts is incomplete, for it shows but a portion of the picture. The record discloses that the damage done to the adversary, after all, is almost negligible, but it fails to take into account the losses and the injuries, moral and material, that boycotts thrust upon China and upon the Chinese people. How great these losses actually are cannot readily be guaged, but a faint idea of their magnitude may be gained in the examination of effects in a single industry in one center. The 34 Japanese cotton mills of Shanghai employ a force of 60,000 Chinese workers and the monthly pay-roll of these workers is Mex.$1,092,000. To consider a single period of three months in 1932 when, due to a boycott these mills closed and their workers went idle, it is seen that the sum of Mex.$3,276,000 has been taken out of the hands of one group in one city, and it is entirely fair to assume that each individual of this group has five dependents. It should not be forgotten, either, that in China this group represents an affluent class—toilers with a wage scale that approximates, at current exchange rates, four dollars a month for the individual in American currency.

The "sovereignty of China" is a hackneyed phrase in the mouths of the country's diplomats. What virtue may lie in this "sovereignty" may be questioned when organizations possessing not the faintest pretext of any legal status take into their own hands governmental authority and administer it under laws of their own making. The following brief news dispatch taken from the *Shanghai Evening Post & Mercury* of December 31, 1932, tells its own story :

Four Merchants Pay Penalty in Canton

Four merchants convicted by the Anti-Japanese Association in Canton and "sentenced to death" for having dealt in Japanese goods, were executed before a firing squad yesterday noon. The penalty was carried out by the Bureau of Public Safety of Canton municipality.

The "executed" merchants were Ho Tih, Loh Chu-ting, Wei Chi-kong and Ho Nga.

What price boycotts and warfare ? These may be expedients of desperation to solve the problem of what China can do in the emergency that confronts her. Are all other methods exhausted ? And are the words of her trusted leaders remembered ? One recalls the admonition given recently at a Nanking Memorial Service by Mr. Yeh Chu-tsang, veteran member of the Kuomintang, who said frankly : "It is no use denying that corruption exists everywhere in China." And at the closing session of the Second National Civil Affairs Conference General Chiang Kai-shek was no less outspoken when he told his hearers. "We must first set our own house in order before we can successfully resist outside aggressions."

The word most commonly mouthed in the councils of foreigners and Chinese and least often acted upon may carry a hopeful formula. This is co-operation, which implies the thing for which the peace seekers are groping, and this is conciliation. It is not too late and, on the record of history, it may be submitted that a modicum of co-operation, yes, even with Japan, may be found best to serve the sore needs of the hour. It is a formula that has been tried, but, be it remembered, it takes two to make a bargain.

When the little known Chinese revolutionist, Sun Yat-sen, was sought by the agents of the Manchus in London and his life was in danger the mantle of British protection was thrown over him and he was saved to carry out his destiny. This was a form of co-operation. When the late Rev. Arthur H. Smith carried to the United States the proposal to remit the Boxer Indemnity and won favorable action for his proposal from the American Department of State an outstanding service was performed for China and a benevolent precedent was set for other powers to follow. When the United States loaned to China Clifford Hewitt, its foremost mint expert and builder, who still is in Shanghai, and when many other specialists in diverse lines came to China from America, from England and from other European countries, and from the League of Nations, they provided needed assistance for China and they succeeded in the measure that China gave co-operation to their efforts. The list of instances is well-nigh endless. The elder statesmen of China remember when the harried Sun Yat-sen sought asylum in Japan. It was in the home of the late Premier Inukai that Sun Yat-sen found refuge. The youthful Inukai not only provided shelter, but he also shared his slender means with Sun Yat-sen and the fugitive's fellow refugees from China to the end that the Revolution in China might live. Through long years of the reign in Manchuria of the late Chang Tso-lin amity between Japan and the northern potentate remained unbroken. In times of strife, in fact, militarists in China proper on more than one occasion falsely accused Japan of giving armed aid to the Manchurian overlord. It was an era of co-operation in the north and those were years of peace and great prosperity for that portion of the eastern world. The formula has stood the test of time and whenever in the past it has been employed China has profited.

The views of the generality of foreign residents in China and the views of their several governments through the years have been much at variance. At Westminster and at Washington the pacifists, the pedagogues and the theorists, deaf to the voice of the man on the ground, have steered the course of events in Asia and we have arrived at length at what China is to-day. Many of the news correspondents in the China field have told the events as they have been unfolding and the unpublished records of every foreign chancellery carry the account of what has been happening. These realities have had to make way for theories, applicable nicely perhaps to conditions in Europe or America but intrinsically incapable of being woven into the different and complex pattern of Oriental life. In the decade since the Washington Conference the policies of the foreign powers have been unfailingly consistent and the policy of China, too, has been consistent. Through the period the powers have been conciliatory and hopeful. The Chinese have been truculent and unresponsive. The factor of co-operation has been absent. A new dogma needs to be found and one exists that cries out to the world for hearing. If the plight of the common people of China, the "stupid people," can be elevated into view as a major theme for the parliamentarians to study and discuss and efforts concentrated upon this broad human subject, at least a new viewpoint would be provided. The natural gifts and the undoubted talents of those astute westernized Chinese diplomats could be turned to the service of their country in no better fashion than this, and the word patriotism then might begin to have a meaning in China. The receptive spirit of the western powers is not to be doubted and, let it be written, the spirit of the Shidehara régime, which kept step faithfully through the years of conciliation, is not dead in Tokyo. In that direction lie the sure recovery to China of Manchuria, and peace and prosperity. The paths that have been followed lead elsewhere. It is fitting therefore, with the aid of an erudite Chinese colleague to say, Ni-Tau-Na-Li-Chu ?—Where are you going ?

Activities in Manchuria

The South Manchuria Railway Company has formally approved plans for developing new industries in Manchuria. After two years of discussion, an aluminium industry is to be started, with factories either at Mukden or Fushun, work on which will be started before the end of this year. It is said that Manchuria can supply a third of Japan's annual imports of aluminium which total 12,000 tons annually, the necessary raw material being found at Fuchou, in the Kwantung Leased Territory, and at Yentai situated on the main line of the South Manchuria Railway. The cost of the project, approximately Y.10,000,000, would be raised by increasing the capitalization of the railway company.

The directors of the railway also recently finally decided to form a company to produce ammonium sulphate, capitalized at Y.25,000,000. Preliminary work will be started early next year and, at the end of two years, it is hoped that 170,000 tons of ammoniates will be produced annually by the new industry, the whole of the production being practically sold exclusively to Japan. It has been decided to erect a factory at Liushutan, near Dairen.

The Japan Coal Association is flirting with the South Manchuria Railway with the hope of establishing a joint Japan-Manchurian sales company for coal in order to control the price of that commodity. The association will formally invite the railway to participate and if the latter accepts, it will be first evidence of economic co-operation between the two countries.

The sales company would fix standard prices for coal and also control production quotas. Capitalization of Y.5,000,000 is mentioned for the new company if it should be formed.

Jehol Province

THAT part of the former Chihli province north of the Great Wall, known since 1929 by the name of "Jehol Province," is unfamiliar to the outside world, owing to the remoteness and inaccessibility of its position. It lies off the beaten tracks in Mongolia, such as the well-frequented Kalgan-Urga caravan route, and is usually passed unnoticed by foreign travellers.

The province is situated on a plateau bounded on the north by the Shara Muren and on the south by the Great Wall. Though this territory has been under the jurisdiction of the Chinese Government since the days of the Han Emperors, when the south-eastern part of Jehol was known as Liucheng under the control of the Governor of Liaosi Chun its agricultural development is only of recent date. In the Tsing dynasty nomadic Mongols often lived side by side with Chinese farmers, and in view of the large tracts of pasturel and available, stock-breeding was more highly developed than farming.

After the overthrow of the Manchu dynasty the Republican Government, for the purpose of facilitating administrative work, separated Jehol from the former Chihli province as an independent political unit, first under the name of "Jehol Special Administrative Area" and in 1929 raised it to the status of a full-fledged province known by the name of Jehol.

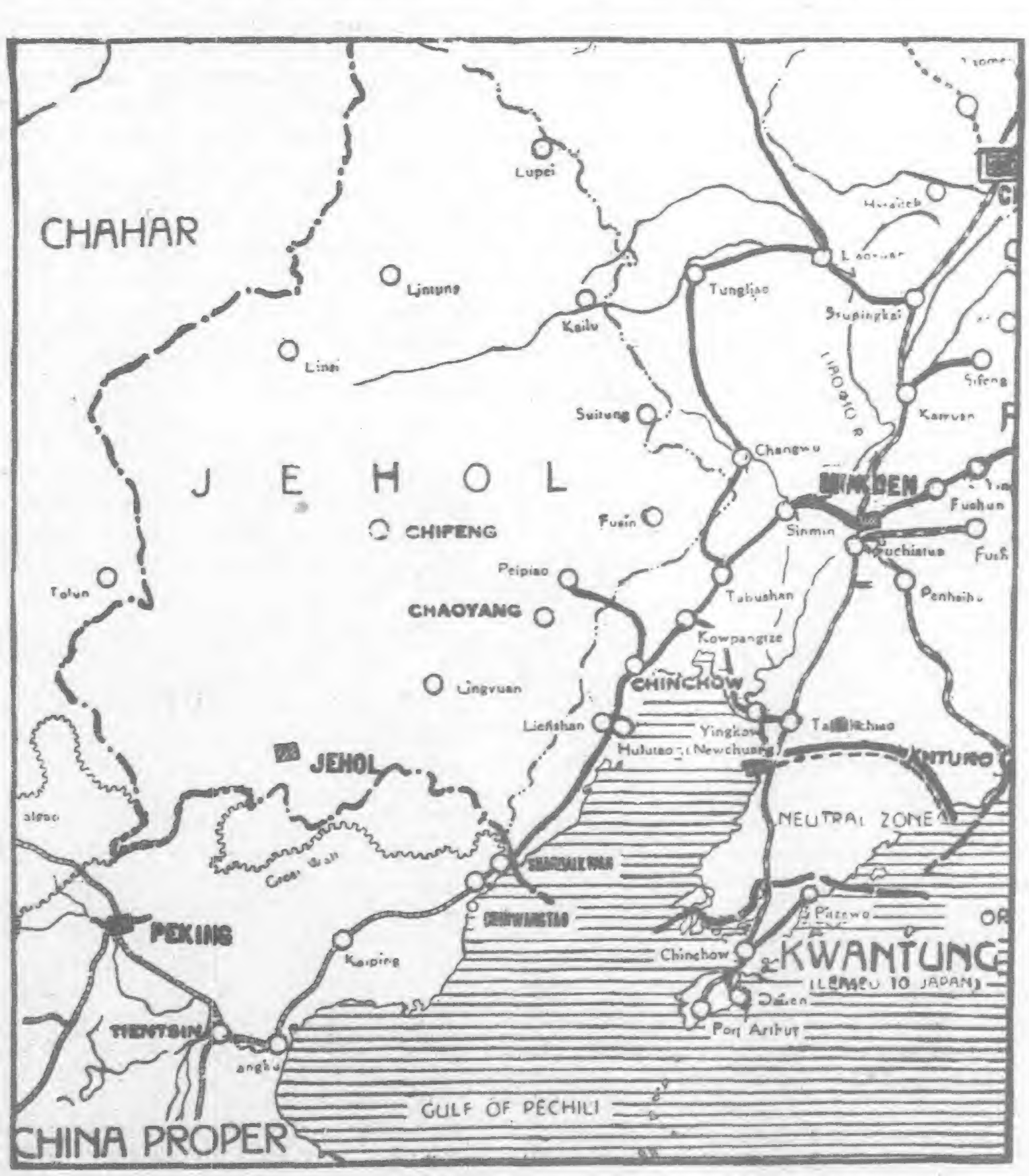
Under the present system Jehol has 16 *hsien* districts, with Chengteh as the provincial capital. The more important districts, either from the agricultural, industrial, or commercial standpoint, are Lwanping, Pingchuan, Chihfeng, Chaoyang, Weichang, Fusin, Kailu and Kingpeng. The province consists of well-developed farms, pasture land, timber tracts, and hilly and mountainous regions, interspersed with patches of alkaline desert, especially in the north-eastern part.

The agriculturally developed districts are rather densely populated. It is estimated that about 30 per cent of the rural population, mostly Mongolian nomads, are engaged in pastoral pursuits, and the remaining 70 per cent in agriculture. The staple crops consist of millet, kaoliang, wheat, buckwheat, beans and tobacco, and are more than sufficient for local consumption, leaving a fairly large balance for export, though in recent years this surplus has been decreasing owing to the increase of local population.

Immigration of farmers has been encouraged by the Chinese Government, and areas of waste land granted to prospective settlers for reclamation. With the aid of local officials, large tracts of timber or pasture land have been brought under cultivation by Chinese immigrants. The neighborhood of Chihfeng, for instance, was formerly covered by dense pine forests, but all the standing timber has been cleared to make room for agricultural development, and the local population now depends on Weichang for its timber supply. The valleys between Kingpeng and Linsi are very fertile and well-suited to the growing of upland crops. The summer, however, is short, and only one crop can be raised, the early crops being harvested in July and the late ones in September, frost setting in early in the autumn.

The wide open spaces of Jehol are full of agricultural possibilities, and immigration of agricultural settlers has been encouraged since the early years of the Republican régime. Where large tracts of arable land are available a provisional government office, known as Sheh Chih Chu is established to encourage immigration and agricultural development. Land for reclamation is divided and allotted to prospective settlers on application. When a district is developed to a certain extent, it is made a *hsien*, and the Sheh Chih Chu becomes the Hsien Magistrate's Yamen. Many new districts in Jehol have been created in this way, and their number is steadily growing. Very recently a new *hsien* district named Lintung was added to those already in existence. This district has a population of over 80,000, and has under its jurisdiction considerable tracts of pasture land, of which a large proportion has been agriculturally developed.

Stock-breeding is pursued mostly by the nomadic Mongols, who, with the arrival of the spade and hoe, are being gradually pushed back to the north. Livestock includes horses, cows, sheep, and camels. One estimate puts the annual increase in the number of horses in the country around Chihfeng at 35,000 head, and in northern Jehol in the neighborhood of Linsi, at 148,500 head. The figures for the annual breeding of cows or oxen for the corresponding two parts of the province are 275,000 head and 53,000 head respectively, of sheep, 459,000 and 250,000 head, and of camels, 640 and 560 head. Draught horses are generally geldings and mares, stallions being kept for breeding purposes. The rutting season lasts about two months, from May to July, during which a stallion mates as many as ten mares. Horses bred in the northern part of the province are very fine animals, their strong and supple limbs making them indispensable as draught animals in rough country like Jehol. To the Mongols the sheep is a very useful animal, providing both food and clothing. The camel is a slow-growing animal, and calves cannot be used for draught purposes until eight years



Shanhaikwan and the North China Area

old, but if properly fed and cared for, a camel can work up to its 50th year. The animal sheds its coat once a year, yielding from three to five pounds of wool, the moulting season being in the summer months.

Wool and skins are other staple products of the province. Sheep-raising is pursued chiefly by the nomads, and by primitive methods. Breeders often care more for the flesh and the skin than for the wool, yet the latter is of excellent quality. With improved methods, such as stock selection and cross breeding, still better crops could be obtained.

The forests of Jehol abound in fur-bearing animals. Sables are found in the north-western part of the province, while foxes and wolves are abundant in the central and western forests. Hunting is done by the nomads and by agricultural settlers as a diversion as well as a slack season occupation. Sables and other valuable fur-bearing animals are usually taken by nets or traps rather than by shooting, because if an animal is killed with a primitive gun, the beauty of its skin is likely to be marred by shot marks, which greatly detract from the market value.

The trading season begins in late autumn, when the farmers have gathered their crops and the nomads fattened their animals or prepared the skins for barter. Chihfeng is the chief commercial center, which forms, as it were, the gateway between Mongolia and Jehol. In all business transactions between the Chinese and Mongols barter plays an important part. Formerly all transactions were carried out in this way, but recently the Mongols have realized the value of silver, and dollars or sycee are being more widely used as medium of exchange. In the autumn every year nomads from different parts of Mongolia flock to Chihfeng, bringing their pastoral products such as wool, skins, and livestock to barter with Chinese traders for such articles as matches, cloth, sugar, etc.

Owing partly to linguistic difficulties and partly to their natural shyness, the Mongols seldom transact business with Chinese merchants directly, but usually invoke the help of the Fan Tou who is at once commission-agent and innkeeper On arrival at Chihfeng, the Mongol trader goes direct to the Fan Tou, handing over all his stock to the commission-agent, and lives on the latter's premises until the Fan Tou has disposed of his stock and obtained by barter such simple manufactures as his client may want. On the completion of these business transactions, the Fan Tou is handsomely remunerated by his client for his service both as commission-agent and innkeeper. The nomads have implicit faith in the probity of the Fan Tou, to whom they leave every detail of business deals without so much as inquiring the terms settled for a transaction. But not all the Fan Tou in Jehol are honest men ; many have grown rich at the expense of their unsophisticated clients.

The principal commodities offered for sale, or rather barter, in Jehol are tobacco leaf and wool-felt blankets. This felt is made by very primitive methods. Sheep-wool and waste silk or cotton-wool are spread on a piece of matting layer upon layer, between which water containing a little mucilage is sprinkled to serve as binder. When the layers of wool have reached a certain thickness, another piece of matting is placed over the top, the wool being thus sandwiched between two pieces of matting. Pressure is then applied. Sometimes the sandwiched wool is rolled into a bundle, tied behind a camel, and drawn along the ground until the matted wool becomes sufficiently compact. Felt blanketing is a very useful article to the Mongols, being employed as blankets, carpets, cushions for the saddle, and coverings for their tents. A piece of felt of best quality, about the size of an ordinary blanket, fetches seven or eight dollars. Very few manufactured goods are turned out by the Mongols, and the felt blanketing referred to is the most important. Crude soda is another commodity produced by very primitive methods, while salt manufactured from brine, or rather deposits in certain saline lakes in the north-western part of Jehol, also forms an important export from those regions.

The mineral wealth of Jehol is said to be considerable, although the mountain fastnesses of the province are not yet fully explored or possible mining areas thoroughly prospected. So far as is known the coal mines at Peipiao and Fusin, north-west of Chaoyang, are most promising. At Liutiaokou, near Chihfeng, anthracite of very good quality is found, and at Hunghwahao bituminous coal is obtained. Chienyenkow and certain neighboring districts not far from Chaoyang are also coalmining districts. At Chikwanshan near Chihfeng, and Pingchuan gold deposits are said to have been discovered, and at Yatukow and several other places near Pingchuan lead has been located. Silver and wolfram deposits are also known of at certain places in the province. Four oil wells or seepages have been discovered ; that at Kiufutang 90 *li* south of Linyuan has been prospected several times and been found most promising. The others are at Lwanping, Ningcheng, etc. In the mountains near Chihfeng, there are waterfalls which could be utilized to generate a considerable amount of power.

Transportation facilities are still lacking in Jehol. Two or three large rivers, including the Lwanho and the Liaoho have their source in the north-western part of the province, but the reaches of these rivers flowing through Jehol are not navigable, and people have to travel overland, using horses as means of locomotion. In the early years of the Republic a rather ambitious program of railway construction was outlined for Jehol by the Government, but up to the present there is only a short railway between Chinchow and Chaoyang, which was formerly a branch line of the Peiping-Liaoning Railway. Between Peiping and Chengteh, the provincial capital, the distance is about 500 *li*, which in former times it took a traveller five or six days to cover. A motor-bus service is now operating between these two places, and the time required for the journey reduced to one day.

There is no accurate record either of the area or population of Jehol. A recent estimate puts the total area of the province at 67,166 square miles, and according to the official register, there are 584,559 families and 3,495,478 inhabitants, of whom 2,166,-146 are males and 1,329,332 females, but it is believed these figures are out of date. With the ever-increasing number of immigrants from the interior, the total population is now believed to be in the neighborhood of 5,000,000.—*Chinese Economic Bulletin.*

Tungsten Shipments from China

During the first quarter of 1932 exports of tungsten from China totalled 117 short tons, more than 100 tons being recorded for Hongkong, where they were transhipped for European or American destinations. Direct shipment of 12 tons to Germany and four to Great Britain make up the rest of the quarter's exports in this class. According to published reports of the maritime customs, 2,266 tons of tungsten were exported from Canton in 1929, 4,844 in 1930, and 5,170 in 1931. In spite of this increase in recent years, local traders expect 1932 exports to drop back to figures approximating those for 1929. There was little active trading in the early months of the present year, and the South China Trading Company and Siemssen & Company have done what little business is known to have been transacted. Many mining concerns have become insolvent and several mines have been closed. The only business known to have been done with Europe by Canton firms was transacted with Germans said to be buying tungsten for speculation. Total unsold stock in Canton and Hongkong together with that held in the mining districts of the interior of Kwangtung and Kiangsi ran between 2,000 and 2,500 long tons during the quarter.—*American Metal Market.*

Bamboo Airscrews

Bamboo aeroplane propellers have been made by a young Japanese aircraft engineer, and have successfully undergone most exhaustive tests.

The invention is of great importance to Japan, where the raw material for making airscrews has always presented a problem. Propellers are usually made of Circassian walnut, mahogany, or duralumin. But neither Circassian walnut nor mahogany grows in Japan, and aluminium—the principal component of duralumin —has to be imported.

By the new process (states Reuter) the arc-shaped bamboo is flattened under a specially-constructed roller after it has been treated with anti-corrosive vapor. Then the pieces are fastened together with caseinglue.

According to a report by the Aviation Research Institute of the Tokyo Imperial University, the new propellers are infinitely more durable and elastic than those of mahogany or Circassian walnut, from 20 to 30 per cent cheaper than the usual types, and practically unaffected by heat and moisture.

Economics of Light Railways for China

By ARTHUR M. SHAW, Consulting Engineer

FOREWORD.—In presenting the case for light, standard-gauge railways, Colonel Shaw has given us material, in his "Economics of Light Railways for China," which not only is interesting and informative, but which is highly valuable and most timely; while his specific example of the Hangchow-Kiangshan Railway gives a most practical turn to the principles advocated.

First and foremost, to the general reader, this work shows how and why China remains in a state of economic under-development, especially in regard to means for inland transportation. He also suggests a concrete, workable plan for increasing her railway mileage at a minimum cost, for immediate future use, and in spite of the financial difficulties which confront China to-day.

Secondly, to the student of railway economics, the study made by Mr. Shaw has presented an addition to the literature on China's railway problems which is constructive and original. Much of the material is the result of careful research carried on for a period of more than two years, and of a close association with the planning and construction of a railway of the type which is described. This has been done with a back-ground of forty years of experience in engineering work which includes his three years of service as technical adviser to the National Construction Commission of the National Government and the Chekiang Provincial Government. This monograph will have a high academic and technical value both in this country and abroad.

Last, but not least, the successful experiment of the Hangchow-Kiangshan Railway, made under the leadership of Mr. Chang Chin-kiang, the former Chairman of the Chekiang Provincial Government, with the strong backing of the banking groups of Shanghai and Hangchow, well illustrates both the advantages and the need of constructive statesmanship on the part of our National and Provincial leaders.

For these reasons, I take great pleasure in recommending Colonel Shaw's authoritative work to the readers of the *Chinese Economic Journal*, and particularly to those students of economics who are interested in China's current transportation problems.—KINN WEI SHAW.

Bank of China, Hangchow, June 16, 1932.

[The following article has a direct relation to a preceding article by the same author on "The Hangchow-Kiangshan Railway," which appeared in the October, 1932, number of The Far Eastern Review.]

THE object of this discussion is, first, to emphasize the urgent need of the Republic of China for a great increase in its railway mileage and, second, to suggest a plan for securing this increase at a lesser cost than would be required if all new lines were to be of the standard, heavy-duty type.

The construction of light railways is advocated to meet the immediate needs. Conditions are enumerated under which these lighter lines are warranted, together with suggested standards and a number of general principles.

Owing to the suggestions frequently made, that narrow-gauge lines would assist in meeting the present situation, considerable space is devoted to the discussion of special-gauge railways, attention being drawn to the insignificant saving in first cost, the effect of a narrow gauge on cost of operation, and the obstruction to traffic flow at points of connection with other lines, of a different gauge. To emphasize these points, reference is made to the disastrous results suffered by other countries, following the introduction of mixed gauges.

The effect of gauge on cost of line is illustrated by means of estimates covering two hypothetical railways, one of standard gauge and the other of one-meter gauge, but with the two lines identical in all other respects.

There is also included a comparative estimate of cost of roadway for light, intermediate, and standard railways; all built to the same standards as regards limiting curvature and grades, but with other standards varying to fit the character of service for which each type might be considered best suited. This is followed by a description of the more important elements entering into each estimate.

A discussion follows of the economic capacity-limit of goods cars, with a graph showing costs of cars of various capacity, ratio of pay load to dead load, and the cost of each type of car, per unit of capacity.

Several tables are included, giving the relative standing of various countries as regards railway mileage, examples of extreme curvature employed on standard-gauge lines and the cost of transporting goods and passengers by the various means which are in common use in this country.

The closing paragraphs are of a general nature, applying to the railway situation in China as a whole.

Introduction

In population, demands of society, and even in industrial development, China has advanced far beyond her transportation system; while for the quick movement of troops and munitions, which may be required at any time for protection against foreign foes, her facilities are woefully inadequate. The road systems constructed during previous generations have not been maintained; it is doubtful if the waterways are as efficient as they were in former years; and the construction of railways and modern-type highways has not kept pace with the growing needs of the country.

If anyone were inclined to doubt the need for more railways, he would be convinced by a survey of the situation in other countries the relative prosperity of which, it is generally conceded, is indicated to a considerable extent by the facilities provided (either by nature or by man) for internal and foreign commerce. As railways are by far the most important single factor of inland transportation, the degree in which they have been developed in each country may be taken as an indication of the material advancement of that country.

Some years ago, Mr. J. E. Baker, adviser to the Ministry of Railways, presented in his *Explaining China* a comparison of the railway facilities in various countries, illustrating his point by a table showing the number of miles of railways per 100,000 population. As the author pointed out, such a table can not be accepted as a true index of the relative adequacy of facilities as there are many factors which it does not take into account. For example, it is doubtful if Australia, with its 404 miles of railway per 100,000 people is as well served as are England, Scotland, Ireland and Wales, which have only 52 miles per 100,000. In this case, the additional factors consist of a more dense population, greater relative length of coast line, more internal waterways and a better developed highway system.

A somewhat better index, but still far from satisfactory, might be obtained by using the figures presented by Mr. Baker, by multiplying these by a "density factor" consisting of the population per square mile. Such a comparison is given in Table I, the first column of figures being taken from Mr. Baker's list; the second from the latest obtainable data on population and areas of countries; and the third is the product of the first two.

TABLE I.—*Railways of Various Countries.*

Country	*Miles of Ry. per 100,000 population*	*Population per square mile*	*Miles of Ry. times Density*
Australia	404	1.85	747
Canada	378	2.6	983
China (not incl. Mongolia or Thibet)	2	225	450
France	64	193	12,352
Germany	57	338	19,266
Great Britain	52	370	19,240
India	11	176	1,936
Italy	31	352	10,912
Japan	12	402	4,824
New Zealand	254	12.7	3,226
Russia	26	17.8	463
Siam	9	45	405
Spain	48	109	5,232
Switzerland	78	243	18,954
U.S.A. (Continental)	261	35	9,135

In spite of the rapid advance in efficiency of other methods, the railway still provides the most feasible, economical, and in every way the most satisfactory means for transporting overland, the bulk of the commerce of the country. Highways are suitable for freight haul over relatively short distances, and for passenger service for somewhat greater distances ; aeroplanes, if speed is of greater importance than cost ; canals and rivers for certain heavy commodities ; and cart, pack animal, wheelbarrow or human porterage if no other system is available—but none of these can compare with the railway in general adaptability and suitability, for the movement of goods and passengers over considerable distances.

While the cost of transportation, without consideration of speed, convenience, protection, and comfort, will not always provide a true measure of suitability, the cost per unit-distance is the best single feature for comparing various means of transportation which may be under consideration. Table II, " Cost of Transportation in China," has been prepared for this purpose. Wide variations from the rates given, will be found, though those which are included in the table will give a fair comparison, under what may be assumed as average conditions. In general, the rates included are those which are common in sections of the country where each type of transportation is in general use. The cost of transportation by pack animals, however, is based on insufficient data and should be viewed with suspicion.

In most cases, the rates shown by Table II will provide only a bare living wage for the laborers, in the cruder forms of transportation (such as porterage and wheelbarrow haul), while those methods which require a large capital investment will provide better wages for the laborer and a fair return on the capital invested.

Not only should the character of service rendered be considered in making a comparison of possible alternate methods, but account is to be taken of the varying prices due to varying commodities and quantities. For instance, the most of the railway lines have adopted a six-division classification of freight, and also, there is a lower rate for carload shipments than for smaller lots. For the purpose of comparison, however, railway rates on large shipments of ordinary materials, shipped for considerable distances, are given.

For those types of transportation, such as rickshaw and sedan chairs, which provide but one class, the rate is shown in comparison with third class of the railways though in essential details, they do not even compare in comfort and convenience with the lowest class of railway service. In the matter of including personal baggage, they are especially deficient.

Only figures from Chinese sources have been used for, while volumes of data could be secured from other countries, especially of the cost of railway and motor truck haul, conditions are so different that a comparison from such figures would be of little interest.

TABLE II.—*Transportation Costs in China.*

Note that distances are stated in kilometers, weights in metric tons and rates in M$.

FREIGHT—Per Ton-kilometer

Type of Transport	*Ordinary Limits Load*	*Dist. per day*	*Rate per Ton-Kilom.*
LAND			
Railways	30	300	0.010
Auto trucks	1.5	150	0.100
Carts (animal drawn)	1.0	40	0.100
Wheelbarrows	.08	25	0.200
Pack animals (see text)	.08	40	0.300
Porterage (human)	.04	25	0.450
WATER			
Junks, upstream	—	40	0.022
" interior canals	—	—	0.019
Yangtze river boats—Upper	—	—	0.116
" " " Lower	—	—	0.020
Coasting steamers	—	—	0.024

PASSENGERS—Per Passenger-kilometer

Type of Transport	*Ordinary Distance per Day*	*Rate per Passenger-kilom., and Class First Class With Berth*	*First Class No Berth*	*2nd*	*3rd*
LAND					
Railways	700	.06	.045	.03	.015
Auto-bus	200	—	—	—	.020
Rickshaw	60	—	—	—	.060
Chair	40	—	—	—	.110
WATER					
Junks—Upstream	40	.020	—	.0125	.006
Yangtze river boats	300	.070	—	.050	—
Coasting steamers	400	.060	—	.035	—
AIR—Shanghai to Hankow (830 kilom. ±)		.240			

Even in one section of this country, there frequently is a wide variation in costs for the same class of service. Wheelbarrow and porterage are especially affected by weather, road conditions, and the immediate supply and demand. Prices for carrying goods by coolies have been known to vary in a small section, from 25 cents to 70 cents per ton-kilometer, and the loads carried, from 30 to 80 kilograms. Over one route of 3½ kilometers, there is an established rate for carrying incense powder, from the small village where it is manufactured to the point of shipment by boat. The cargo for a strong man is 80 kilograms and the price paid for carrying is equivalent to 50 cents per ton-kilometer.

If we accept the figures of Table II as being fairly representative, the only reasonable substitutes for the railway are the motor-bus and trucks on good highways and boat service on canals and rivers where these are available. As each of these is able to render efficient service in the particular field for which it is suited, and as they are adaptable for some service for which the railway is unsuited they should be developed in a manner which will contribute most to the welfare of the country.

Considering present, and probable future needs, the rational procedure would appear to be the preparation of a comprehensive transportation plan for the entire country, with rail lines serving as the main arteries ; highways to serve both as feeders to the railways and as independent radial units at important centers ; with canals and rivers to be utilized in those sections where they are feasible and can be used to advantage.

In advancing this idea of a general transportation plan, no claim is made of originality. It is stated more for the purpose of emphasis. Government officials have repeatedly stressed its necessity and have done a considerable amount of constructive work in its direction.

By following such a plan, destructive competition will be avoided and the day will be hastened when every section of the country will have access to a modern means of transportation.

Type of Railways to be Built

Recognizing the two facts ; that there is an urgent need for a great increase in facilities for interior transportation, to meet the demands for social, economic, and political progress ; and that the construction of railways will most nearly meet these demands ; there remain the most pertinent questions—" Where shall these railways be built ? " and " What standards shall be adopted in their construction ? "

It has been stated by men well informed regarding the local economic situation that ; " Given a stable, well administered government, a railway could be constructed in almost any section of China and it would become a paying business from the start." The truth of this is well illustrated by the history of the Peiping-Hankow line which did not follow established lines of commerce and for which it was not claimed, even by its promoters, that it would become profitable for a number of years. And yet it proved to be a profitable investment almost immediately. With peaceful conditions prevailing in China, and freedom from outside interference, there is scarcely a railway in the country which can not be operated at a profit and, at the same time, contribute to the welfare of its patrons and of the section which it serves. If it were possible immediately to treble the mileage of railways of the country, and

then to continue construction at the rate of several thousand miles per year, the needs of the country would not be exceeded ; but governing conditions dictate a more deliberate procedure. If from no other cause, the limited funds available for railway construction place an obligation on those in responsible charge to select those lines for early construction which will most nearly meet the present needs.

Not only does the limitation of funds affect the routes to be selected for early construction, but it should, in many cases, dictate the type of construction. The standards as promulgated by the Ministry of Railways are well suited to lines handling moderately heavy traffic and it is quite possible that the greatest ultimate economy could be secured by adhering to these plans for such lines as should be built during the next few years, if each line were to be built with the sole idea of an independent business investment. It is certain however that for many of the future lines, their territory could be well served by lighter, and correspondingly cheaper, construction, making it possible to build a greater mileage within a given limit of funds.

This discussion will deal principally with these lighter lines, present conditions indicating that they should be built in considerable numbers, and continued as light railways until such a time as capital (from outside sources or from earnings) may make it possible to revise them to higher standards.

For convenience, an arbitrary classification will be adopted, based on the weight of rail employed. This will consist of :—

Industrial and special lines—Rails of 30 lb. and less per yd.

Light railways—Rails of 35 to 45 lb. per yd.

Intermediate railways—Rails of 60 to 75 lb. per yd.

Standard railways—Rails of 85 lb. and over.

Also, only two gauges will be considered, a "narrow-gauge" of one meter and the "standard-gauge" of 4-ft. 8½-in. A representative example of light railway construction will be discussed in detail, this line being designed for 35 lb. rail and with track structures, rolling stock and other features consistent with the limits imposed by the rail. There may be conditions warranting the construction of a railway of still lighter material and design but these would be special and the problems could be of only local interest.

The reason for adopting the 35 lb. rail is that it is about the minimum section which can be employed satisfactorily in ordinary railway service if types of rolling stock and methods of operation similar to those employed on standard lines are to be used. Even with such rail, it will not be feasible to interchange rolling stock with standard railways freely, though all cars of moderate size can be handled in the terminal yards of the light railway, and the light cars can be handled on standard lines with little trouble.

There is another reason for the consideration of the 35 lb. rail, which will be important so long as it lasts. The combination of steel manufacturers maintains a minimum-standard price for all rails which are in common demand but rails which are not covered by this understanding (and this applies to 35 lb. sections and lighter) may be purchased on an unrestricted, competitive basis.

As a result of this free competition, quotations for 35 lb. rails recently have been made at a price not greatly exceeding 50 per cent of the cost per ton of the next heavier section. This condition may be only temporary but it is worthy of consideration.

While the 35 lb. section is suggested as the minimum, it definitely is not recommended for use on all lines for which only limited funds are available. Excepting for very light traffic, a heavier section is preferable, even if this should require a considerable sacrifice in such items as alinement, ballast and spacing of sleepers. The additional investment required for the heavier rail will (up to a reasonable limit) yield greater net returns on a line of moderate traffic, than will a similar amount invested for almost any other single item, excepting only drainage and reduction of controlling grades. The section of rail definitely limits both the axle loads and train speeds and each of these will be an important factor in fixing the ultimate capacity of the line. They will also have a marked effect on the efficiency of operation, long before this capacity has been reached.

In the later discussion of the light, intermediate and standard railways, it will be shown that the change from 35 lb. to 45 lb. rail will result on only a small increase in capital investment, provided that all other items remain the same.

Were it not for the fact that a light railway may be converted to a standard railway at a very small increase in ultimate cost, one would hesitate in recommending the expedient of the cheaper construction but, with conditions as they are, it seems that the wise course would be to adopt the lighter and intermediate standards for all new lines of the immediate future, excepting only those few which may almost certainly be required for heavy service during the first few years of operation.

Considering first, the objections to such a course, it is probable that, within the next few years after operation is started, demands of traffic will outgrow the capacity of the light railway ; the cost of operation, after a medium traffic has been developed, will be greater than for a heavier line; and the required increase in efficiency and capacity can be secured only by providing heavier rails and rolling stock of greater capacity. There probably also will be required some strengthening of track structures.

As opposed to some of these objections, and tending to minimize others, it will be possible to build a line of given length for less money—or stated otherwise—a greater length of line can be built and a greater area served by a given investment ; there will be a saving in interest on the investment which will more than offset the loss in operating efficiency until a heavy traffic has been developed ; when re-construction becomes necessary, relieved rails may be profitably employed in the construction of branch lines and sidings ; the original rolling stock will be suitable for use on branches, and on local trains of the main line ; and if later revision is considered in the initial design and construction, the additional expense (over what they would have cost if originally built to standard), necessary for revising track structures, can be all but eliminated. This will be practically true of tunnels, particularly true with trestles and culverts, but probably not applicable to important truss bridges.

The Design of a Light Railway

General Principles.—In preparing plans for a cheaper type of construction, the prime objective should be to create an instrument for efficient transportation which will be consistent in design, and will yield the greatest possible returns, both in service and earnings ; and to do all this at the lowest possible cost. So far as it can be done without defeating this main objective, the plans should include provisions for a later revision to higher standards. In many details, the cheaper line will simply be a scaling down in size of elements (though seldom in quality) from the standards found best suited for more important lines. This will be true of the weight of rail used ; size and capacity of locomotives and cars ; load capacity of all temporary track structures ; and many other items.

A probable future revision to higher standards will influence the location of the line, the adjustment of grades and even the details of such structures as culverts, wooden trestles and masonry supports of important bridges. Even for a light railway, reasonably good alinement is important while heavy grades may be even more of an objection than on a line for which extra heavy and powerful locomotives may be provided for special conditions.

There are many expedients which may be adopted for reducing the initial outlay and which will not materially add to the ultimate cost of the revised and improved line. Frequently-broken grade lines, which would not be suitable for long trains, operating at high speeds, are not particularly objectionable for short, slow-speed trains, and by proper planning of the work, these can be corrected when required, without serious inconvenience to traffic. Culverts with long barrels, and practically no headwall, can be constructed as cheaply as shorter culverts with large headwalls. The former type lends itself well to later widening of embankments which may be necessary for a wider roadway standard or for grade reduction (which usually includes track raising and embankment widening in the valleys). Pile and timber-frame trestles can be constructed (at no greater cost) to permit the later addition of an extra pile or post, and an additional pair of stringers, and this revision can be made without interruption to traffic.

In some cases, the additional expense necessary for the later revision should be included in the initial construction. This certainly is true of tunnels, which can be made suitable for any class of service at only a slight increase over minimum requirements while a later enlargement, with consequent interference with traffic, would be a serious and expensive procedure.

Long-span bridges will present a special problem, each of which should be judged on its own merits. There is no known method by which such a bridge, designed for light loads, may be re-modeled economically, to fit it for heavy loads. For this reason, the initial structure should be built for the heavier loading if it appears reasonably certain that such service will be required in the near future, a lighter structure being provided if an early increase in loading appears to be improbable. In any event, the masonry supports should be suitable for the heavy construction as this will add little to the initial cost and can not be provided later without great expense.

Excepting as already indicated, the general principles of location, alinement, grade adjustment and similar features remain true for all railways, from those handling the lightest to the heaviest traffic. These have all been so thoroughly covered, in works which are available to all, that a discussion at this time could be of little value. Many books and papers have been written on the subject but in scope, and a thorough consideration of all phases, none of them approaches the monumental work by the late Arthur M. Wellington—*The Economic Theory of the Location of Railways*. Some of the data presented are now obsolete, on account of the advances made in the last few years, but the principles of economics, which he has set down are as true to-day as when first written.

ALINEMENT AND GRADES.—Mention already has been made of the use of broken grade lines as a means of reducing first cost. With traffic of only moderate density, it frequently is possible to raise sags and widen embankments by train service, at a lower cost per unit of material placed, than was possible in the original construction. This is especially liable to be the case if long hauls are involved. By the use of a work train, material excavated in widening cuts may be hauled for several miles and utilized for embankment widening and raising.

While a revision of grade may be a comparatively easy and inexpensive operation, resulting in a minimum of wasted material and labor, a revision of alinement is a far different matter as it entails the complete abandonment of all earthwork and the most of the track structures. A wholesale waste of this nature should be avoided, even if it is necessary to hold the first cost to the lowest possible limit. If a particular section demands the use of excessive curvature which would not be permissible on a higher-type railway, it usually will be possible to limit the length of such objectionable sections in a manner to reduce so far as possible, the amount of line which later may be abandoned. In the case of a single very sharp curve, skirting a bluff, the approaching tangents should be placed to permit later improvement by making a widened cut in the bluff, or a tunnel, if this is the apparent best method of improving the line. The change can then be made with a minimum of disturbance to the line and at much less expense than would result if the future revision was not planned in the original construction.

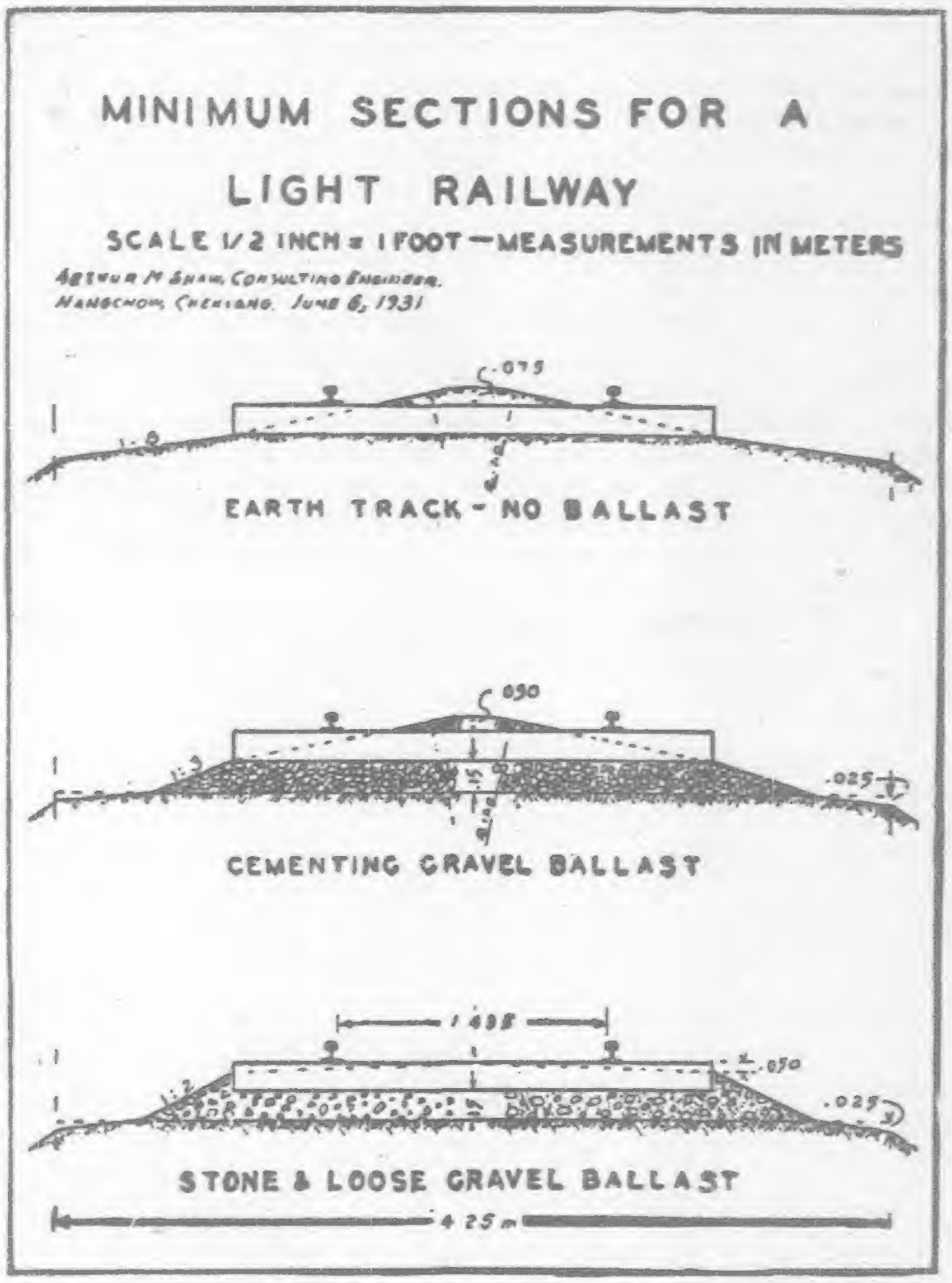
Engineers frequently incur more expense than is warranted, in an effort to secure extra long tangents and light curvature. Excepting on lines operating fast passenger trains, the expenditure of large sums to avoid curvature is seldom justified by the savings effected in operating costs.

ROADWAY SECTIONS.—The width of roadway to be adopted will depend on so many factors that a single standard can not be devised which will be best suited to all conditions though it is obvious that the width found best suited for important, heavy-duty lines would be unnecessarily expensive for a light railway. Under average conditions, and assuming that the railway will be ballasted for a depth of six inches under the sleepers, a minimum width of 4.40 meters on embankments, and between the side ditches of cuts should be provided. This should be increased at bridge ends and other important points. A general increase to a minimum width of five meters should be one of the first forward steps to be taken when funds for improvements are available.

BALLAST.—In this item, a substantial saving from standard practice may be made without any considerable sacrifice in riding qualities of the road, safety, operating costs, or cost of maintenance. The moderate axle loads employed and the low speeds of the light railway do not demand the depth of ballast required for heavier service. Several of the important trunk lines of the U.S. use twelve inches of sub-ballast, with another twelve inches above this and under the bottoms of ties; or a total depth of ballast (including that between the sleepers) of over 2½ feet.

For a light railway, at least for the initial period of operation, six inches of ballast under the sleepers should be sufficient. This will require from 700 to 800 cubic meters per kilometer of track, depending on the section adopted.

Not only can a saving in quantity of ballast be made, but the quality (hence the price) may be somewhat below that usually specified for more important railways. For the first application, gravel of an inferior quality, or even sand, may be employed though



care should be exercised in the selection of materials used as sub-ballast. Coarse, cementing gravel (containing a considerable proportion of clay) frequently is used successfully as top-ballast but such material has no place as a sub-foundation for track, the clay content making it impossible to provide the drainage which is possible when used as an upper layer, and which is essential to its successful use.

Many first class roads advocate the use of a fine material as sub-ballast, using anything that is readily available, such as engine-house cinders, quarry screenings or sand. Expensive crushed rock, applied directly to a new roadbed, will nearly all be lost by sinking into, and mixing with, the earth, while the finer materials appear to mix with the top portions of the embankment to a lesser degree.

Where the soil is more or less sandy, it may be practicable to operate for a few years without ballast, or with ballast only in cuts and at other special points. Until about forty years ago, it was common practice in the U.S.A. to construct new lines with no provision for ballast. As they became available, cinders were used at the points giving the greatest amount of trouble and, as traffic increased, gravel pits were opened and the track was gradually ballasted. Broken stone later came into general use, though there are still many miles of important lines which are ballasted with gravel.

If good gravel is obtainable, at a price materially below that of broken stone, the former should be used on all lines which have only a light, or moderate, traffic. The section adopted should be varied to suit the class of material employed; following closely the accepted standards for rock ballast if the gravel is "loose"

and free from clay, and more nearly approaching the section suggested below for earth track, if a cementing gravel is used.

If advisable (or necessary) to operate for a considerable length of time without ballast, a special track section should be adopted which will insure the best possible drainage of the roadbed. Excepting in very sandy soils, this section should be practically a reversal of that which is generally considered suitable for rock ballast. For example, it has been found necessary to avoid heavy tamping at the center of rock ballasted track, to avoid "center-bound" track, while with earth ballast, there is no danger from this source. On the contrary, the entire space between the rails should be well tamped, the center crowned to a level with the tops of the rails, and the sides sloped down to the bottoms of the sleepers at their ends. The accompanying suggested standards show the section of "Earth Track" which was generally found most suitable in the U.S.A.

While the reasons for initial operation without ballast are usually financial in their nature, there are certain economic advantages to be gained, other than a postponement of capital investment. A year or more of compacting of the sub-grade under traffic makes it possible to secure a better and more permanent foundation than is possible if ballast is applied at the time that traffic is first started. Many railways have found that if ballast is deposited on a new embankment, much of it is lost by sinking into, and becoming mixed with, the earth sub-grade, not only resulting in a loss of the material but also creating an undesirable pocket for the collection of moisture.

When it was undertaken to rush through the construction of the railways which were built after the American occupation of the Philippines, it was found that while the plans called for only 1,500 cubic yards of ballast per mile, nearly 4,000 cubic yards were placed in securing an effective depth of six inches under the sleepers, practically all the excess having disappeared into the sub-grade.

One extreme case which came under the writer's observation, included raising of the track to a height of several feet for the purpose of reducing a grade. The raising was done on gravel while the sides were built up from earth taken from adjacent borrow pits, this borrowed material being a tenacious clay. Trouble did not begin for several years after the work had been completed but it finally became so serious that it was necessary to build a temporary trestle for carrying traffic, excavate the faulty material by steam-shovel, and replace it by suitable material hauled in by train. The central reservoir, formed by the core of gravel, had gradually saturated the clay of the sides so that slides occurred frequently, making it impossible to maintain a dependable schedule over this section.

That the troubles described above were not primarily due to faulty material is shown by the fact that the original embankment, which had been in service for over thirty years, had been constructed from clay from the same pits and had never caused any serious trouble.

Gauge of Railways

Although this country has constructed but a fraction of the railways necessary for its immediate requirements, it may be taken for granted that the standard gauge which, with few exceptions, has been adopted throughout the Republic, will be adhered to in all future lines that are planned to form links in the general system of the future. A still wider gauge might prove economical for exceptionally heavy service, but development already has progressed too far for a change in that direction, even though it might appear to be desirable.

For light railways, a narrower gauge of 2½-ft., 3-ft., or one meter frequently is suggested while the *Ko-Pi-Lin-Ping* Railway in Yunnan Province is of 2-ft. gauge. These narrow-gauge lines offer some undoubted advantages under certain conditions, but the objections to their use are so many, and of so serious a nature, they should never be considered excepting for the few rare cases in which the advantages to be gained are substantial and certain and where the objections may be reduced to the minimum.

To give force to the above statement, the various claims which are advanced by the advocates of narrow-gauge lines are first listed and then discussed in detail, as follows :—

Claimed Advantages of Narrow-Gauge Lines

(*a*) They can be operated with safety and economy around sharper curves than are permissible for standard-gauge lines, hence effecting a saving in grading, especially in mountainous country.
(*b*) Lighter track, track structures, and equipment may be employed, greatly reducing the cost.
(*c*) Operating costs will be less, due principally to the lighter-weight rolling stock.

Before entering into a discussion of these claimed advantages, it might first be well to consider the effect of mixed gauges on the transportation system of the country as a whole.

It is obvious that, other things being equal, it would result in a great economic waste to construct any line to a special gauge if that line may later be in a position to serve as a link of a general system, or even to serve as an important feeder to such a system. When such a stage of development has been reached, the special-gauge line will be faced with two alternatives, neither of which is attractive to operating officials or investors. One possibility will be to transfer all goods and passengers at junction points while the other will be to reconstruct the line to standard gauge.

The extra tax on the revenues of the line, if the former method is followed, might easily result in a net loss in operation ; and the cost of the latter, involving the reconstruction of all track and track structures, and scrapping of all rolling stock, would be staggering if not prohibitive.

With the possible exception of a few short lines, built exclusively for special industrial purposes, and perhaps excepting a railway system for the Island of Hainan, there is scarcely a railway in operation or contemplated, in this country which should not eventually become an interconnected part of a general rail transportation system, and which should not be constructed in a manner which will fit it for such service at the least cost for revisions and adjustments.

The history of railways in other countries is replete with illustrations of the folly of permitting varying gauges. The last special-gauge line of any importance in the U.S.A., the Denver & Rio Grande Railway, was able to maintain its unique position for many years, owing to its isolated location and the conditions which made it possible to charge the exceptionally high rates that are noted later. In spite of these unique advantages, the need for quick and economical transfers at junction points ; coupled with the necessity for more economical transportation, caused by gradually encroaching competitive lines, forced even this railway, with its several thousand miles of track, to change to standard gauge. The entire system was reconstructed, with the exception of a few, unimportant branch lines, and the most of the rolling stock disposed of for practically the price of scrap.

Limitations of Alinement.—As will be more fully shown in a following section, any comparison that is to be of value must be made comparable as to details. For this reason, in considering the matter of alinement, we should compare narrow-gauge equipment and operation, not with those of a heavy-traffic main line, but with a light railway of standard gauge, equipped with cars and motive power, and operating at speeds that are identical with those of the narrow-gauge line.

While it is true that a narrow-gauge train can pass around a curve which would be too sharp for the normal operation of standard-gauge equipment, the limits of permissible curvature for the latter are not nearly so restricted as is commonly supposed. The following list of small-radius curves in actual use up to recent times on important, standard-gauge railways, is given to illustrate the feasibility of sharp curves for meeting special conditions. This list was taken partly from "Location of Railways" already mentioned and partly from the writer's own experience :—

Table III.—Examples of Sharp Curves on Standard-Gauge Railways

Name of Railway	*Location*	*Radius in Meters*	*Remarks*
N. Y., N. H. & H.	Springfield, Mass.	125	Main Line
Baltimore & Ohio	Harper's Ferry	122	" "
" "	" "	92	" "
" "		43	"Y" track used only by "consolidation" locomotives.
Illinois Central	Louisville, Ky.	73	Main Line
Virginia Central	Rockfield Gap	72	" "
Pennsylvania	Pittsburgh	67	" "

A personal observation of the operation of regular trains over a half of the curves given in the above list, and a second-hand knowledge of all the others, indicates that in no instance has there been any serious operating difficulty encountered on any of them. The writer was in charge of track maintenance on the Louisville Division of the Illinois Central, which included the 24 deg. curve mentioned, and can recall but one derailment on this curve, this being caused by a defective wheel flange. Several passenger trains passed over this curve daily, each consisting of an "Atlantic" type of engine, standard day coaches and several Pullmen cars.

In converting the Denver & Rio Grande Railway to standard gauge, several of the 24 deg. and 30 deg. curves (73 and 59 m. radii) were continued in use.

Certainly on a curve of 80 m. radius, and probably on one of 70 m. radius, properly constructed, standard-gauge rolling stock can be operated at fully as high a speed, with an equal degree of safety, as is possible with a narrow-gauge line. On curves of longer radii, the factor of safety at equal speeds becomes increasingly favorable to the wider-gauge line.

COMPARATIVE COSTS OF ROADWAY AND EQUIPMENT.—The idea that a narrow-gauge railway is materially cheaper in first cost is so generally accepted that considerable space will be devoted to a discussion of this point.

As usually built, there can be no doubt that the popular impression is correct, but its truth depends mainly on the fact that narrow-gauge lines usually are of low capacity, built for only moderate speeds, and frequently they are of the most flimsy construction. The only way in which a true comparison can be made is to assume a railway of each gauge, these being designed to render identical service; for a railway is of value only on account of the service which it renders, and the amount and character of this service form a true gauge of its value.

From the nature of their design, narrow-gauge railways are limited in the size of transportation units, and in train speeds. For this reason, a standard-gauge line is assumed for comparison which will fall well within the limits commonly considered suitable for narrow-gauge operation.

In order that the subject may be treated in a concrete way, a hypothetical railway of each gauge has been planned, these two lines each being 150 kilometers in length and built through a reasonably easy country, with no tunnels, major stream crossings or other exceptional features, but under conditions which easily may be paralleled in many sections of China. Following are the elements assumed for each line:—

50 Freight cars, each of 12 tons capacity.
12 Coaches, capacity of 50 passengers each.
6 Locomotives, 54 tons each.
35 lb. rails.
Sleepers to afford 2⅓ sq. ft. of supporting area per lineal foot of track.
Depth of ballast (from top of sleepers), 12 inches.

An estimate of the cost of each of these lines is given in the following table.

TABLE IV.—COMPARISONS OF COSTS OF STANDARD-GAUGE AND NARROW-GAUGE LIGHT RAILWAYS

No.	*Description*	*Standard Gauge*	*Narrow Gauge*	*Difference*
1	Sleepers	264,000	264,000	—
2	Ballast	307,500	270,600	36,900
3	Grading	1,116,400	1,068,400	48,000
4	Concrete Culverts	222,250	216,590	5,660
5	Timber Bridges	500,000	500,000	—
6	Tracks (exclv. of sleepers)	1,256,200	1,256,200	—
7	Shops, Water Sta's and Bldgs.	100,000	100,000	—
8	Track Tools and Miscl. Equip.	15,000	15,000	—
9	Rolling Stock	984,000	984,000	—
10	20% for right of way and miscl.	953,000	953,000	—
	Total (150 kilom.)	$5,718,350	5,627,790	90,560
	Per kilometer	38,122	37,485	637

$$\frac{90,560}{5,718,350} = 1.58\%$$

The various items of these estimates are given as follows:

1.—*Sleepers.*—These are given first both for the reason that they are frequently mentioned as constituting one of the major items of saving by use of the narrow gauge, and because the length of sleepers used may determine, to a certain degree, the dimensions of ballast and roadway sections, and lengths of culverts.

The two principal functions of track sleepers are:
(*a*) To hold the two rails to proper gauge.
(*b*) To serve as a spread foundation for the rails.

It is in connection with this latter feature that by far the largest amounts are spent for roadway maintenance and hence, it is of major importance to operating officials and, as affecting net revenues, to investors.

For the present purpose, we may assume that the supporting power of this spread footing is in direct proportion to the supporting area. Under this assumption, it is obvious that for the identical service contemplated, the supporting area for the narrow-gauge line should be the same as for the standard-gauge line.

Besides serving as a spread footing, sleepers must have sufficient thickness to permit their acting as a beam and to hold the track spikes. This latter requirement demands a thickness of not less than five inches.

Basing the track design on a minimum of 2⅓ sq. ft. of supporting area per lineal foot of track, the economical dimensions for sleepers probably would be 5-in. × 7-in. × 8-ft. for the standard gauge track and 5-in. × 8-in. × 7-ft. for the narrow gauge. In each case, the sleepers would be placed on 2-ft. centers and would contain the same amount of material per lineal unit of track, and the cost per unit of length of track will be the same.

To reduce complications in the estimate, it is assumed that the same type of sleepers will be used throughout the line, over bridges as well as on embankments and, for this reason, they will not enter into the comparative estimate of bridges.

2.—*Ballast.*—The estimates of this item are based on the assumption that a suitable supply of gravel may be procured at some point convenient to the line, and that a section of ballast will be adopted which is equivalent to that indicated by Fig. I for "Loose Gravel Ballast." For the standard-gauge line, the theoretical section calls for 656 cubic meters of ballast per kilometer of track though, in actual practice, from 20 per cent to 30 per cent more will be required, the exact amount depending on the condition of the sub-grade. The estimate was based on a cost of $2.50 per cu. m. of ballast in place, with a 25 per cent increase in quantity over the theoretical section.

On the narrow-gauge line, the use of sleepers of shorter length will permit an estimated saving of 12 per cent of the ballast, or an estimated total saving on the 150 kilom. line of $36,900.00.

Even if the sleepers were reduced to seven inches in width and six feet in length (dimensions frequently employed on narrow-gauge lines) and a corresponding reduction made in ballast section, roadway embankments and culverts, the total saving, as compared with the standard gauge, would amount to less than $1,500.00 per kilometer, and this reduction would result in a great sacrifice of stability, with a substantial increase in cost of maintenance and operation. The resulting railway would, in no way, be comparable with the standard-gauge line specified.

3.—*Grading.*—While a 14-ft. (4.25 m.) roadway is indicated by the accompanying Fig. I as the minimum, it is assumed, that the lines contemplated by the foregoing estimates, built through an easy country, would be justified in adopting a somewhat greater width. The estimates are based on a roadway width of sixteen feet for the standard-gauge line and of one foot less for the narrow gauge, this reduction in width of roadway corresponding to the reduced dimensions of sleepers and ballast section.

In estimating the grading for these two hypothetical lines, it was assumed that there would be a total of 60 kilometers of cuts and 90 kilometers of embankment, about three-fifths of the excavation (not including side-borrow material) being rock. The total cost of all grading for the standard-gauge line was estimated to be $1,116,400.00 and the saving effected by the one foot reduction in width of cuts and fills, to be 4.3 per cent, or a net saving in this item on the entire line of $48,000.00.

4.—*Timber Bridges.*—In spite of the high cost of structural timbers, and their short life, there are many stream and canal crossings in this country for which a timber structure is a practical necessity. For such of these as may be found necessary, it is estimated that $500,000.00 will be required. As the volume, and nature of traffic; axle loads and train speeds will be the same on the two lines, regardless of gauge, the design of the timber bridges will be practically the same and the costs will be identical.

5.—*Concrete Culverts.*—In many sections of the country, materials other than concrete can be used to advantage in the

construction of culverts but for the purpose of easy comparison, none but concrete culverts were included in the estimates. For openings up to 12 sq. ft. section, concrete pipes were provided and for larger openings, six feet arch culverts were included. For openings greater than that afforded by twin culverts of six feet span, timber bridges were provided.

All culverts were planned to be constructed with extra-long barrels, with headwalls of negligible size, as before suggested. Disregarding the cost of headwalls, the cost of such culverts will be approximately in proportion to their length, and this was assumed in computing the saving effected by use of the narrow gauge.

6.—*Tracks.*—As the labor and material will be identical for the two gauges, there will be no difference in this item.

7.—*Repair Shops, Water Stations and Other Buildings.*—It is possible that an insignificant saving might be made in the size of the engine house but, with this possible exception, the cost of all items under this heading will be unaffected by the gauge.

8.—*Track Tools and Miscellaneous Equipment.*—These will be affected in no material way by a change in gauge. There will be a slight difference in the construction of trolley cars but, for cars of equal capacity, manufacturers quote the same price, regardless of gauge.

9.—*Rolling Stock.*—This item makes a particularly strong appeal to the average, non-technical man. He usually takes it for granted that a narrow-gauge car or locomotive is comparatively inexpensive. On account of this popular impression, it might be well to repeat; the foregoing estimates are based on two lines which are as nearly identical in all details as possible, considering the difference in gauge. As will be shown later however, complete equality can not be attained, on account of certain unsurmountable limitations of the narrow-gauge railway.

With this equality of service in mind, it is obvious that the locomotives and cars for a light railway which is to render a given service, should be of the same capacity, regardless of the gauge of the line. This uniformity of capacity will be assumed throughout, though in some cases of actual practice, this might present some difficulties. For instance, there has been no logical design prepared for a fifty-passenger car for use on a narrow-gauge railway though this is an economical and common size for light railways of standard gauge. The usual alternative for the narrow-gauge line is to build cars for a smaller number of passengers, thus increasing the cost per passenger-unit of capacity.

With special reference to locomotives, letters were sent to a number of manufacturers, inquiring particularly regarding the comparative cost of standard-gauge and narrow-gauge equipment. Uniform specifications, quite in detail, were furnished to each manufacturer, they were limited to sizes commonly employed on narrow-gauge railways and provided that, so far as practicable, the engines quoted should be the same for either gauge.

Various replies to these inquiries were received but from none of them was it found that either locomotives or cars could be purchased cheaper if narrow-gauge equipment were specified, while some stated that this would increase the price from five to fifteen per cent. The unit sizes specified were approximately the same as those included in the above estimates.

One manufacturer states: "Our experience indicates that for engines of similar weight, dimensions and pattern, differing only in gauge, there is no appreciable difference in cost. What extra expense is involved in the greater cross-measurements, is quite compensated for by the reduced length, as the greater distance between frames permits of widening and shortening the fire-box, with a corresponding reduction of length of frame and wheel-base."

Another manufacturer replied that the difference in gauge presented special difficulties in the construction of a well proportioned fire-box. Necessary modifications in fire-box and engine framing made it necessary for his company to charge a higher price for a narrow-gauge locomotive than would be quoted for one of equal capacity but of standard gauge.

Concerns making a specialty of freight cars advise that the saving in width of trucks of narrow-gauge cars is offset by the additional length required or, if the length of body remains the same and height increased to secure the required capacity, the cost is materially increased. If the body-dimensions of cars follow closely those of standard-gauge practice, large orders will be accepted at practically the same price, regardless of gauge, but if special body-construction is required, or if the order is comparatively small, the cost of narrow-gauge cars will be the greater.

From the foregoing, it is apparent that, if there is any difference in cost of rolling stock, it will be in favor of the standard gauge.

Cost of Operation.—Many experiments have been made to determine the frictional resistance to train movement as affected by the radius of curves, gauge of track, length of wheel-base, and type of trucks. From these, it has been deduced that:

(*a*) Other conditions remaining the same, the effect of narrowing the gauge is small. One experiment showed an advantage of 4 per cent in favor of the narrow gauge in operating on a curve of 100 m. radius, at a speed of 27 kilm. per hour. The advantage was greater at lower speeds and less at higher speeds. On straight track, in good condition, there is no appreciable difference.

(*b*) Other conditions remaining the same, decreasing the length of wheel-base materially decreases curve resistance. No exact method has been devised for computing this gain but the recorded experiments would indicate that it is approximately in proportion to the reduction in length of wheel-base. To apply this practically, we may assume a standard-gauge goods car of 12 ton capacity, with a 22-ft. wheel-base; and a narrow-gauge car of the same capacity but with a 30-ft. wheel-base.

From the foregoing, we may deduce that on a curve of 100 m. radius, the narrow gauge might produce a saving of 4 per cent of tractive effort required but, due to the necessary increase in length of wheel-base, this would call for 36 per cent additional power, or a net loss through the use of the narrow-gauge cars of 32 per cent.

To serve as a summary of the foregoing discussion of narrow-gauge lines, the following is quoted from the book on railway location by Wellington, already referred to:

> "Whatever conclusion may be reached as to the proper standard of curvature for lines of fair traffic, it is certain that for a road to which the last degree of economy is essential, the intelligent use of sharp curvature offers one of the simplest, most effective, and most expedient methods of economizing in first cost."
>
> "A further advantage of so economizing is that at many points, the works may assume a mere temporary character for present necessities while being adapted for ready improvement in the future."

Table V.—Comparative Cost per Kilometer of Roadway and Structures of Various Classes

Classes as Represented by Rail Sections

Pounds per Yard		35	45	60	75	85
Kgs. per Meter		17.36	22.32	29.76	37.20	42.16
Rail and Fastenings Tons per Kilometer		37.49	48.43	64.66	80.38	90.92

Cost per Kilometer by Items

1	Sleepers	$1,760	2,320	12,300	15,400	15,400
2	Ballast	2,050	2,050	2,600	3,173	3,900
3	Grading	7,442	7,442	8,100	8,700	9,325
4	Timber Bridges	3,333	3,333	3,650	3,980	4.200
5	Concrete Culverts	1,482	1,482	1,600	1,720	1,800
6	Track (excl. sleepers)	8,375	10,800	14,420	17,900	22,500
	Totals per Kilometer	$24,442	27,427	42,670	50,873	57,125
Per cent of 35 lb. rail		100	112	175	208	233
Per cent of 85 lb. rail		43	48	75	89	100

Note that the cost of materials of foreign origin was estimated on the basis of M$4½=G.$1.00.

> "The belief in the narrow-gauge as an expedient and defensible system of construction, which was from the beginning chiefly founded on illusion and delusion, is rapidly passing away and all but gone."
>
> "As respects rolling-stock, there can not be a question that there is absolutely no practical advantage in the narrow gauge. Any reputable locomotive builder will contract to build engines of the same weight and power for either gauge, which will traverse the same curves, for the same price. The standard-gauge engine, in fact, will, or can, have enough shorter wheel-base, because of its greater width, to make it take curves a little better. The same is essentially true of cars."
>
> "The bridges and trestles are, of course, not affected by the width of gauge, if rolling stock of the same width and weight are to pass over them."

"The earthwork and masonry are affected only by whatever difference there may be in the width of the road-bed, which can not properly be more than the difference in the width of gauge. The ties may be only about three-quarters the usual length, but only at the expense of decreasing the stability of the track and increasing the labor required."

"There remains therefore, as the net gain from the narrower gauge, only the slight saving in grading and ties, which may amount to one to four per cent of the total cost of the line."

The author also emphasizes the fact that "the cost of maintaining track to a given standard of excellence is greater" and "the maintenance of rolling-stock is decidedly more costly."

In writing of the Denver & Rio Grande Railway (which then was still operating as a narrow-gauge railway but since has been changed to standard-gauge) the author states:

"The success of this line had little or nothing to do with gauge, but was due rather to the fact that it was cheaply built, and was assured a monopoly of a remunerative and growing traffic at very high rates—rates from three to eight times higher than were usual on lines farther east. Its narrow-gauge system was complete in itself, and connected with standard-gauge lines at but few points."

It was only a few years after the above was written, that all of the main line and the more important branches of the Denver & Rio Grande were changed to standard gauge. The high cost of transfer at junction points, and the sharp competition of newly constructed, standard-gauge lines, with their lower operating costs, were the principal causes of this revision of gauge. The bulk of the passenger business, between competitive points, was taken over by the new lines as the passengers preferred the better riding qualities of the wider cars.

From the foregoing data and estimates, and in the light of experience in other countries, there does not appear to be a single argument, that is worthy of consideration, for the further introduction of mixed railway gauges into that country. The transportation problems to be faced by the next generation will be sufficiently difficult without the addition of this wholly unnecessary burden.

Intermediate Standards

As already explained, the 35 lb. rail was assumed as being about the minimum section which may be considered for operation under conditions demanding ordinary, commercial service. There will be many occasions however, for the consideration of standards which are intermediate between this and the 85 lb. section now in general use on the main lines of the country. An attempt will be made in the following to work out a rational comparison of costs of a number of such intermediate lines, using as a basis of estimates for all, the same 150 kilometer line already described, but modifying the various details in harmony with each standard. To illustrate the method of modification followed; a 60 lb. rail could be placed on the same sleepers, using the same ballast, road-bed and structures contemplated for the 35 lb. rail, but it would be more logical to assume that if 60 lb. rails are provided, there will be a corresponding elevation of standards in other directions, in order that a consistent design may result.

As a convenient "label" for each type or class of line included in the estimates, the weight of rail (in pounds per yard) will be used.

In estimating the costs of the heavier standards, as represented by the 45, 60, 75 and 85 lb. rails, the total cost of track and switches in place will be assumed as being proportional to the weight of rails and fastenings. This introduces an error but it is so slight that it may be disregarded in an estimate prepared only for the purpose of comparison.

The accompanying Table V gives a comparative estimate of cost of five standards, including the 35 lb. standard already described and the four heavier standards above-mentioned. It will be noted that the transition in costs, from one standard to the next, will not plat on a smooth curve. This is due to the radical changes made in some of the items, in shifting from one standard to the next. The reason for this will be seen from the following explanation of methods followed.

1. *Sleepers.*—For the two lighter sections, it was assumed that sleepers from native timber would be used. With the exception of the greater thickness of sleepers (made necessary by the longer track-spikes required) the same standards were maintained for the 35 lb. and the 45 lb. rails. This is done for the reason that neither of these lines would be in a position to accept freely, all rolling stock which might be offered by connecting lines. The light-weight rail would necessitate limiting axle loads and only the lighter cars of the other lines could be handled over the main lines.

For all lines but those of the lightest, on which the initial cost must be kept to the lowest possible limit, there can be no doubt that the higher cost of sleepers which will insure a long service, is well justified. Native timber is contemplated for the 35 lb. and 45 lb. standards as it is assumed that these very light rail sections would not be chosen unless under the most stringent financial limitations.

The sleepers provided for the 60 lb. rail will be suitable for use with the heavier standards, though as renewals are required, sleepers of greater section may be substituted.

For the immediate future, there appear to be but two courses open for securing sleepers which will give a long life in Chinese railways; either the selection of timber (probably imported) which will resist decay and be otherwise suitable, or to import sleepers which have been given a preservative treatment. It is possible that conditions may warrant the use of steel sleepers though it does not appear that past experience will justify their general use in this country until further improvements in their design and manufacture have been made.

In spite of this increase in cost of special timbers or treated sleepers, there can be no doubt that they will effect an ultimate saving over the use of short-life, untreated material.

At the earliest possible date, provision should be made for the preservative treatment of sleepers and general construction timbers in this country. Even for those sections not supplied with any native timber it would be an economy to use imported pine, treating this with creosote or other preservative, after arrival in this country. It is possible that the plants at Pukow and Hankow could be rehabilitated for this purpose though they would be entirely inadequate in capacity under a normal program of construction.

Pine that is suitable for track sleepers can be grown in this country in comparatively few years and there should be an extensive planting of suitable varieties on unused hillsides. Within one generation, this country should be able to supply its entire requirements for such timber, without encroaching on agricultural lands.

2. *Ballast.*—Starting with the 45 lb. standard (which is to be the same as the 35 lb.), a proportional increase in ballast was assumed, up to the standard adopted by the Ministry of Railways for main lines. For each type, it was assumed that a 25 per cent increase over theoretical quantities would be required to provide for waste, and for loss of ballast in the sub-grade.

3. *Grading.*—As with the ballast, it was assumed that the 85 lb. standard would conform to the sections as adopted by the Ministry of Railways. In addition to the increased width of road-way, provision was made for a reasonable improvement of the grade line. The alinement was not to be disturbed but short sags in the grade line would be taken out to permit the operation of fast and important trains.

4. *Timber Bridges.*—The same general type of structure was carried through the series, but provision was made for more piles per bent and for more stringers, to care for the increasing loads. Estimates for all these bridges were based on the use of untreated, imported pine timbers and piles, the idea being that in all cases, these would be considered as temporary structures, to be replaced by steel or masonry. It is probable however that in many cases, the use of treated timbers for such structures would be warranted. Also, in some localities, permanent masonry structures can be built at a lower first cost than that of a suitable timber structure.

5. *Concrete Culverts.*—In accordance with the method previously suggested, culverts for the narrower road-beds were planned with long barrels and practically no head-walls, an extension of the barrel, or addition of head-walls, being provided to meet the requirements of the higher-class lines. It was contemplated that there would be some additional culvert expense as the result of raising sags in the grade line.

6. *Track Work.*—It is the section of the rail, more than any other one item, which limits the service to be given by a railway, but in order that the investment may be well balanced, the increase in the standard of excellence of any one item should be accompanied by that of others. As already noted, however, an exception was made in the transition from the 35 lb. to the 45 lb. standard. Incidentally, this affords an excellent opportunity for comparing the effect on total cost, of increasing the section of rail, with only minor

changes in other items. Thus we find that a ten-pound increase in rail weight adds to the cost only $3,000 per kilometer, including the increased cost of the thicker sleepers. To secure a measure of the advantage gained by this heavier rail, an average of permissible axle loads (as given by manufacturers of twelve different locomotives) was taken. This shows that an increase of axle loading of 27 per cent may be secured by this 12 per cent increase in investment for roadway.

For the very lightest traffic lines, the above point could be of only academic interest, but as the traffic increases to a point where train capacity is limited by axle loads and motive power, it will become of increasing importance on account of its effect on operating costs.

The cost of double-tracking frequently can be avoided, or postponed, by the use of heavier rail which will permit the use of more powerful locomotives, with longer and heavier trains.

The foregoing discussion should not be understood as a recommendation of the various items, as described, for each standard, regardless of circumstances; or even that they represent the most economical arrangement for average conditions. The material has been assembled more for the purpose of comparison, and to illustrate the effect on initial cost, of various modifications. It is easy to imagine conditions, for example, under which the interest of economy would be served by the use of road-bed and all other accessories conforming to the 45 lb. standard excepting that 60 lb. would be used. Such a course would be dictated clearly by the following combination of conditions:

(*a*) A fairly serviceable local supply of timber, available for sleepers.
(*b*) Imported sleepers difficult to secure and extra-expensive.
(*c*) Prospects for an early development of traffic to a point which would overtax the lighter rail.
(*d*) Capital obtainable to cover the additional cost, amounting to approximately $3,500 per kilometer.

On account of the wide variety of demands of the heavier lines in such items as shops, water stations, station buildings, rolling stock and miscellaneous equipment, these have all been omitted as being of little interest in making a comparison of cost. With the exception of rolling stock. these items will be affected as much by other factors as by the character and cost of roadway. There are a few general principles regarding some of these items, however, which have become well established and which are mentioned in the following.

Repair Shops.—A serious mistake frequently is made by building railway repair shops of too permanent a nature. It is a good plan, especially for a new project, to design these, including the engine house, of the cheapest practicable construction, consistent with efficient operation and full protection. One high railway official has recommended that engine houses be built with concrete walls only up to the height of the windows, with timber construction above, each section of eight stalls being isolated by a fire wall. His answer to a criticism for using such cheap construction, on a railway which could afford the best, was: "I have been compelled to tear down many fine structures built of brick and stone, by my predecessors and I do not want to bequeath to my successors any qualms of conscience." This replacement of permanent construction was demanded by a rapidly growing railway, which had outgrown its early facilities.

Besides the danger of obsolesence due to increased size of locomotives, it frequently is found that even the main repair shops have been erroneously placed and that better service can be rendered from some other point. If inexpensive buildings have been erected, the move can be made as soon as its desirability is clearly demonstrated.

Water Stations.—On most lines, there will be a few logical, or arbitrarily fixed locations for water stations, though the extent of demand on even these may be affected by the growth of traffic and the methods developed for handling it. To afford flexibility in meeting future demands, it usually will be better to provide for only a moderate increase over the estimated needs of the first few years. This will hold down the initial investment and no heart aches will be caused if it should be found necessary to move some of the stations.

Station Buildings.—The same general principles will apply to these facilities as have been stated for repair shops and water stations. Even at the outset, reasonable conveniences and protection should be afforded to passengers, and full protection to freight; but the higher refinements of permanent buildings, station parks, soft seats and similar accessories may well be left until the line is on a sure financial basis, or until outside competition makes necessary, the addition of some of these decorative features. Here again, there is always the possibility that after a few years of operation, a change may be found desirable in order that some important center may be served, or that full advantage may be taken of a new feeder system of highways.

Rolling Stock

The size, capacity, and type of rolling stock are so intimately related to the standards of permanent way that are maintained, that one can not be discussed intelligently without considering the limitations of the other. On lines using the minimum weight of rails, economy usually will be served best by employing the largest capacity of rolling stock which the track will permit but, as will be shown later, this will be true of the heavier lines only under certain special conditions.

Locomotives.—No effort will be made to discuss the types of locomotives best suited to various classes of service, other than as regards the two most essential and vital features; axle loads and tractive power. With the minimum volume of traffic, a locomotive of somewhat lesser weight than that fixed by the rails might serve but with 35 lb. or 45 lb. rails, it is doubtful if such a saving in first cost would be justified. A train can be hauled by a locomotive having 25 per cent excess of power, with no appreciable waste but if the locomotive is that much under-powered, the additional cost of operation will be excessive, resulting in slow speeds, doubling over hills, payment of overtime to crews, etc.

Goods Cars.—The transportation problems of this country, especially as they affect, and are affected by, the size and type of cars employed, are so peculiar to each locality that no one may assume that because a certain car has proven satisfactory in other localities, it should be adopted generally in China. Experience gained in other countries can be applied locally only if the governing conditions are known to be identical, or at least, comparable. There is one question however which has been given much attention in American and European countries which appears to have a close parallel in this country; this being the question of open *vs.* closed goods cars. Probably more on account of the longer average hauls, closed cars are more in demand in Canada and the U.S.A. than in European countries. In the matter of length of haul, it is reasonable to expect that as they become further developed, the railways of China will more nearly compare with those of the American continent than with those of Europe and that it will be found desirable to increase the number of closed cars employed.

While certain commodities can he handled as well in open cars, and others could not be handled successfully in any other type, the closed car has many advantages in the transportation of materials which can be loaded into them conveniently, some of these advantages being:

Protection against the weather and pilfering.
Lower insurance rates.
No tarpaulins to be mislaid or stolen.
If properly locked, it is not necessary to send a special man to accompany the shipment.

Including as "closed cars" all stock, poultry, and tank cars, of the railways of the U.S.A., these constitute more than one half the total number of freight cars in service, the detailed distribution being as shown by Table VI.

Table VI.—Freight Cars of various types in use on the railways of the U.S.A. in 1925, as reported by the American Railway Association.

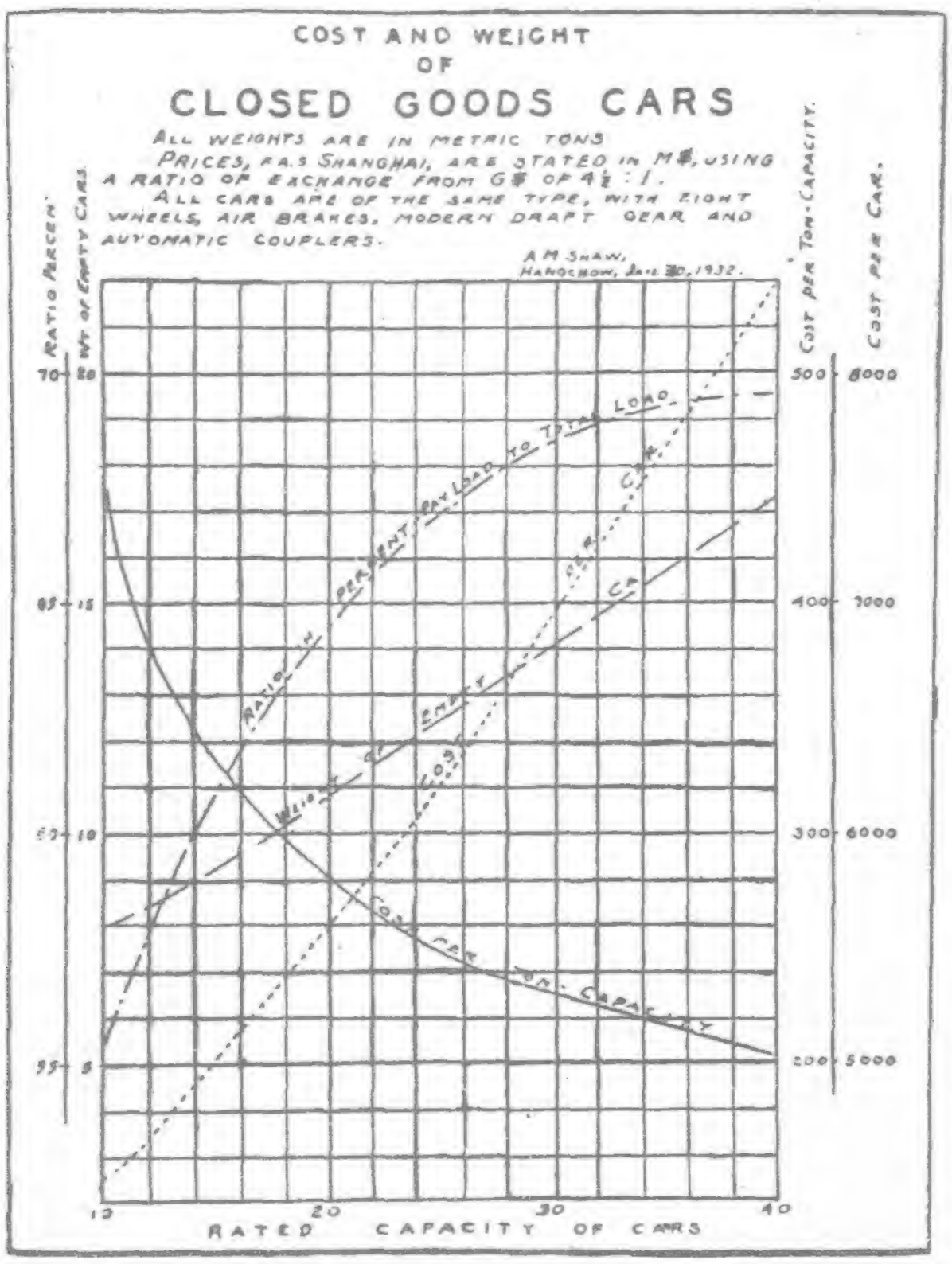
	No. of cars in service	*Percentage*	*Totals No. of cars*	*Percentage*
Closed Cars.				
Box, Plain	1,029,663	33.8	—	—
Box, Special	195,180	6.4	—	—
Stock	97,483	3.1	—	—
Poultry	2,327	.1	—	—
Refrigerator	146,825	4.8	—	—
Tank	148,637	4.9	1,620,115	53.1
Open Cars.				
Flats	137,461	4.5	—	—
Gondolas	573,180	18.8	—	—
Hopper and Coke, etc.	545,070	17.9	1,255,711	41.2
Miscellaneous and Non-Revenue	—	—	172,147	5.7
Total			3,047,973	100.0

Especially in the U.S.A. and Canada, many special types of cars have been introduced for the main purpose of saving labor in loading and unloading. With the present low labor costs in this country, many of these would be an unnecessary luxury though for such commodities as coal, bottom-dump or tipping cars should show an economy if the terminal facilities are designed for their use.

It probably is the size and the capacity of individual cars which should be given the most careful attention, as the economical limits of these most vitally affect the economy of operation. Owing to the variation in governing conditions in other countries, exact parallels which might serve as a guide in such matters, do not exist. Even on a given line in this country, methods of production and merchandizing may, and undoubtedly will, undergo a change which will have its effect on both the amount and character of service to be rendered by the railways.

As an aid in the study of the effect of size of car units on cost, the accompanying graph has been prepared. This is based on size, weights, capacity and cost of closed goods cars, fully equipped, though cost and other details of open cars will run approximately parallel to these.

A novice might deduce, from this graph, that the cheapest car to purchase is the largest car though, while this will prove to be the case under certain very specialized conditions, it requires but a most superficial study to demonstrate the fallacy of the idea as applied to



the local railway situation in general. The strength of the track, as determined by the section of rail employed, is only one of the determining factors. Practical limitations of loading, as fixed by cargo available, is frequently of even greater importance.

While there are no figures available on which to base such a statement, it appears probable that for the lightest railway described in the foregoing, the maximum size car which the track will support should be employed, this affording a capacity of twelve, or possibly fifteen tons. Special conditions may dictate otherwise though this is doubtful, on account of the very rapid increase in cost (per unit of capacity) of the lower-capacity cars. It should be noted in this connection, however, that the ratio of cost to capacity, as indicated by the graph, will not hold true in regard to four-wheel cars though these have not been considered for use on the lightest lines as the load of even a twelve-ton car, supported on only four wheels, would be beyond the safe limits of 35 lb. rail. It is quite possible, however, that on heavier lines, the use of four-wheel cars may be warranted to meet certain conditions.

On large systems, there is no economy in holding to one standard size of cars if traffic conditions can be met better by the use of two or more sizes, though within reasonable limits, standardization has many advantages. At least the couplers, draft gear parts which require frequent renewal, wheels, journals, journal bearings, and similar parts, should be standarized as fully as possible.

Even in countries which are exceptionally well suited to secure maximum car loading, it is found that the actual loading of cars is far below the theoretical capacity. In his book on *Railroad Freight Transportation*, Loree states that, in spite of the great industrial centers in the U.S.A. and other factors which tend toward full loading of cars, the official records for the year 1918 showed an average loading of all freight cars of only 10 tons per car, though the average capacity of these was 30 tons per car.

Loading to theoretical capacity can be more nearly reached in some classes of service than is possible in others. As an illustration, cars loaded with coal at the mines frequently carry 10 per cent more than their rated capacity. As there is every inducement for full loading at the mines, it is seldom that a car is sent out without its capacity load, the result being that cars which are engaged exclusively in hauling coal from mines may average capacity loading, in one direction. The return trip necessarily will be made with light loads, if not with empties. In such service, it may be seen from Table VII that the best showing is made by the largest-capacity car which it is practicable to operate, even when all cars are returned empty.

TABLE VII.—RELATION OF CAR CAPACITY TO PAY LOADS HAULED (IN COAL SERVICE) ASSUMING 100% LOADING FROM THE MINE AND RETURN TRIPS TO BE MADE EMPTY. ALL WEIGHTS IN METRIC TONS.

Rated capacity of car	*Per cent of Total*		*Tons kilometer haul of car, per ton-kilometer haul of pay load*
	Pay load	*Car*	
10	51.0	49.0	1.92
12	53.8	46.2	1.72
15	57.2	42.8	1.49
20	61.7	38.3	1.24
25	64.8	35.2	1.09
30	66.9	33.1	0.99
35	68.7	31.3	0.91
40	70.0	30.0	0.86

By considering Table VII in connection with the graph showing the cost of cars, and assuming that the cost of coal cars will run parallel to that of the closed goods cars it will be seen that both in first cost (per unit of capacity) and in cost of operation, the maximum of economy is secured by the use of the larger units. In no case, however, would it be wise to adopt a car size which is not well within the limits fixed by other facilities, such as track, track structures, cargo handling facilities, etc.

FINANCIAL.—Together with a full realization of the needs of the country for an extension of its means of transportation, there must be a practicable, workable, and far-seeing plan for financing the railways that so obviously are required.

Many advocate full Government ownership and operation, while others hold to the opinion that additional railways can be obtained in sufficient numbers only by the use of private capital.

Without attempting to discuss the relative advantages of Government *vs.* private ownership, it might be well to consider some of the phases of each, as they may be assumed to have a bearing on the rate of railway construction of the near future.

To build a railway as a Government-owned project, with a view to Government operation, it will be necessary that it be constructed, either by the use of funds from the public treasury; or capital must be borrowed for the specific purpose, pledging as security, the physical properties of the railway and its revenues. With the existing tremendous and unescapable demands on the funds and credit of the Nation, the former course scarcely appears to be feasible, while the latter undoubtedly would require so many concessions, in the form of guarantees to the private investor, as to practically defeat its purpose.

While it may be generally conceded that, for military and political purposes, certain lines should be as nearly as practicable under complete Government control, it is apparent that if private capital is to become interested on a large scale, sufficient inducement in the form of a reasonable return on the investment must

be offered and this object can be secured best through private ownership and management.

Assuming that private capital (both foreign and domestic) is to be invited to assist in the extension of the present railway system, there remains to be established a general policy under which such ventures are to be administered. Past experiences, both in China and elsewhere, appear to have established certain fundamental truths in regard to railways which have become almost axiomatic ; while the satisfactory solution of other, and perhaps fully as important problems, has not yet been reached. Two of these generally accepted principles may be stated as follows :—

> Judged purely as a private investment, for private gain, a privately owned railway, operating with a minimum of governmental supervision and restrictions is more efficient than a railway which is owned and operated as a Government enterprise.
>
> As opposed to this, civilization has advanced too far to tolerate an industry which so vitally affects the prosperity and welfare of the whole Nation, as does an important railway, to be exploited with regard only to the profits accruing to private capital.

There is no known method by which all of the advantages of each may be secured, without its attendant evils. The nearest approach to such a plan would appear to be one which would provide State control in matters affecting the interests of the public, leaving the details of management in the hands cf private capital. If it is decided to invite capital to participate in such a development, the desired co-operation doubtless can be secured most readily by adopting and promulgating a definite policy regarding the relations which it is proposed to establish between the State and investors. An attempt to anticipate, in minute detail, the requirements to be imposed, doubtless would be undesirable, but the fundamental principles might well be given. These should be sufficiently liberal to attract capital, but should protect the public from any possibility of exploitation. The degree of liberality to investors necessarily would be greater during the earlier years than would be required after the country has become fully stabilized and the general system of administration perfected.

The following points appear to be worthy of consideration in connection with such a plan :—

1. The least possible interference by the State, with the affairs of the railway, consistent with the interests of the public.
2. Maintenance, by the railway, of a State-supervized, standard system of accounting.
3. Provision that annual net profits from operation, not exceeding an agreed maximum, shall be retained by the investors as their return on the capital invested.
4. Provision that profits in excess of this specified maximum shall be devoted to :
   (*a*) Reimbursement to investors, to cover any shortage, below the specified maximum, which may have been suffered in any previous year of a term of limited duration, say a period of five years.
   (*b*) Any remaining balance to be divided on an agreed basis, between the State and the investors.
5. Provision for taking over by the State, on a previously specified, equitable plan, and at the expiration of a specified period, of the entire property.
6. Provision for taking over, by the State, as a temporary measure and during a time of extreme emergency, including a provision for equitable reimbursement, the entire property or any part of it.

Provisions five and six, together with stipulations regarding such subjects as : character of service to be rendered and minimum amount of service ; standards of construction ; general route ; training Chinese employees in responsible position; limiting numbers of foreign employees and other details might well be left for adjustment to each individual enterprise. It is well to remember, however, that provisions relating to acquisition by the state, either as a temporary or a permanent transfer, must take full cognizance of the generally timid attitude of prospective investors when such features are involved. Unless these investors can be assured of equitable treatment, they will seek another investment, perhaps promising a smaller net return, but one which appears to them to be less hazardous.

Without, in any way, sacrificing its sovereign rights, the State is compelled to recognize the fact that an agreement which contemplates the transfer of a franchise, in consideration of a specified investment is, in the most of its essentials, the same as a contract between two individuals. Any plan which does not provide equity, justice and protection to both parties to the contract is doomed to failure.

Only with the fullest knowledge of the needs and the limitations of the country, coupled with an appreciation of the resources and limitations of private capital, will it be possible to devise a plan which will secure to the people the greatest measure of service and benefit and, at the same time, be sufficiently attractive to investors to secure their interest.

Conclusion.—Methods which have been developed in other countries may be studied to good advantage by economists who are striving to give to China the efficient transportation system to which her people are entitled, and which her economic conditions demand, but not even the best of such methods may be adopted blindly. Each must be given a most careful study and, in most cases, this study will show that substantial modification of methods and standards are required if they are to be of the greatest service in this country. Unique problems are presented which are without close parallels in the growth and development of transportation systems in other sections. In the aggregate, these will have a great influence on the design, and methods of operation of the railways of the country. In the following are mentioned some of these problems which are either peculiar to China or which, at least, do not exist in so marked a degree in other countries.

China is one of the largest countries of the world, both in area and in population, but with railways amounting only to about five miles for each million of population, and even with that small mileage very unevenly distributed.

The economic development of the country, which has reached an advanced stage without adequate transportation, may be expected to undergo a gradual change as modern facilities are provided, revolutionizing agriculture as well as industry. Crops which are not well suited to a given section will be abandoned, permitting that section to devote its resources to more profitable staples, and to supply its needs of the items previously produced, from other sections which are better suited to their production. From this cause alone, there will be built up a traffic which will be advantageous to all concerned but which now is practically non-existent.

Shipments of cereals will continue to be made in small lots until there gradually comes a readjustment which will follow with better transportation systems. It is probable that a concentration of such shipments will later be effected through some sort of private or Government purchasing agency. If properly operated, such a central agency would be a benefit to the producer, the consumer and the transportation systems. Of particular interest to the latter will be the resulting increase in total volume of traffic and also the delivery of produce in quantities which will permit more economical handling.

There are now comparatively few mines and no large industrial establishments demanding a daily supply of whole trains of cars to handle their output though the gradual evolution which will result from the construction of an adequate transportation system will eventually result in such demands.

The development of highways, and truck transportation present new features and possibilities for the creation of a comprehensive transportation system, affording opportunities which have not existed in other countries, where the railways have been developed without regard to a logical relation with other methods of handling goods and passengers.

Many of the canals of the alluvial plains will be abandoned, or used only for local transportation and as drainage and irrigation canals, while some of those which are strategically located will be improved by the addition of gravity locks and arranged for hauling of special commodities by power. In a like manner, navigation on some of the smaller rivers will be abandoned on account of the difficulties which it will not pay to overcome, while other river will be improved by control works, dredging and the construction of canals and locks for passing difficult sections.

If properly planned, canal and river improvement, highway development and the construction of additional railways, all will be

designed to combine into a logical national system of transportation.

A discussion of the railway problems of the country should not close without some attention being given to the human element which will enter into their construction and operation. This is desirable not only on account of the peculiar conditons of labor in this country, but because it is a feature which has been given all too little attention by economists of other countries, in their writings of railway matters. In the excellent book already referred to, President Loree brings this matter forcibly to the attention of his readers. In quoting from a talk which he gave before the American Railway Engineering Association, he shows that the published " Proceedings " of that Association (which in 1912 had reached a total of 9,000 pages) could be divided into the following classes :—

Problems of Roadway	12%
,, ,, Track	30
,, ,, Major Structures	28
,, ,, Minor Structures	15
,, ,, Miscellaneous	15
	100%

Even under " Miscellaneous," practically nothing was found which treated of the human element of railway construction and operation.

Following this analysis, the author states that the cost of maintenance of the railways of the United States amounts to $300,000,000.00 per annum, of which 56 per cent is paid out as wages. He follows this with the statement that—" it would seem to justify the suggestion that your Association devote at least a substantial portion of its work to the study of labor." As a result of this suggestion, the A.R.E.A. has created a special committee which has taken up the study of labor as affecting the problems of railway maintenance.

It is probable that in China, labor does not constitute quite so high a portion of the total cost of maintenance, yet it certainly is the largest single item of cost and is a subject which well may be given attention by every man occupying an executive position.

Regardless of whether the railways of the future are to be Government owned and operated, or operated by private interests under Government control, establishing and maintaining proper relations between employer and employee in the railway service will become of increasing importance, not only to the railways alone, but to the entire Nation. As the railways grow in mileage, and in number of employees, this relation will be found to carry an influence far beyond the limits of the railway organization, tending toward stabilization, or disruption, of relations with labor in other channels.

With just treatment of labor and the managing staff, fair wages, the cultivation of a feeling of security of employment so long as loyal service is rendered, and intelligent supervision, there can be developed an esprit de corps which will make for higher standards of performance, lower operating costs, and generally better service—the railways will be efficient, smooth-working public utilities, contributing to a tremendous degree to the welfare of the country. Without these, there will be chaos, inefficiency and a general breakdown in the railways which will have a disastrous effect on the entire Nation. It will rest with the men who are delegated to direct the policies of the railways, whether these are to be models of efficiency, or deplorable examples of inefficiency.

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Information regarding transportation costs was kindly furnished by various agencies, especially the Shanghai office of Thomas Cook and Son and the staff members of the Chinese Maritime Customs. Dealers and manufacturers of railway equipment furnished much valuable assistance.

Dyestuffs in Japan

IN 1931, reports the U.S. Assistant Trade Commissioner at Tokyo (" Commerce Reports," June 13, 1932), there were thirty-six dyestuffs producers in Japan, whose capital invested totalled Y. 21,000,000 and whose annual production amounted to 9,000,000 kilogs, valued at Y. 9,000,000. The Japanese Government lists thirty dyestuffs, on which it pays subsidies to manufacturers, twenty-nine of which are produced locally. The Japan Dyestuffs Manufacturing Company, the Miike Dye Factory, a branch of the Mitsui Mining Company, the Teikoku Dyestuffs Manufacturing Company, and the Hodogaya Soda Company all produce certain of the specified dyes on which subsidies are paid.

THE AGREEMENT WITH GERMANY

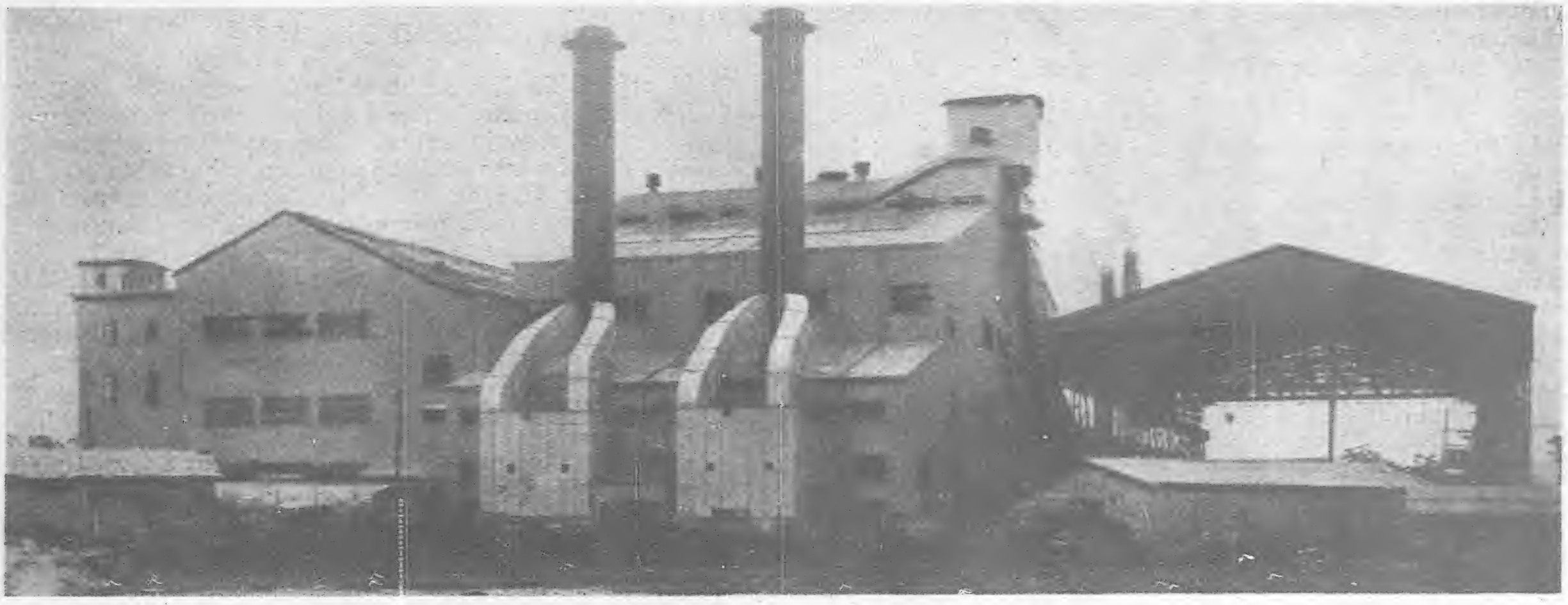
The import tariff of Japan has been changed from time to time in order to give protection to the domestic industry, and in 1928 a commercial treaty was signed with Germany whereby that country undertook not to export to Japan dyes which could be manufactured there. Other German dyes are still imported under a licence from the Department of Commerce and Industry.

JAPANESE PRODUCTION AND IMPORTS OF DYESTUFFS

(Quantity in kilogs ; value in yen.)

Dyeing Class	*Production*	*Imports*	
	1930	*1930*	*1931*
Basic.			
Quantity	257,632	153,700	163,968
Value	1,071,580	1,011,154	1,040,874
Direct.			
Quantity	605,635	436,230	475,066
Value	1,699,210	1,338,188	1,639,404
Acid.			
Quantity	239,966	213,828	273,829
Value	647,150	888,224	1,108,301
Mordant and acid mordant.			
Quantity	52,688	198,908	255,198
Value	213,955	626,504	989,924
Sulphur.			
Quantity	6,472,947	83,977	97,651
Value	2,312,311	266,345	275,994
Artificial indigo.			
Quantity	94,452	397,950	594,525
Value	431,524	970,817	1,328,790
Other vat.			
Quantity	40,393	85,567	108,990
Value	103,304	604,325	777,857
Other colours.			
Quantity	—	24,490	28,599
Value	—	103,679	124,312
Total :			
Quantity	7,763,713	1,574,650	997,826
Value	6,479,034	5,809,236	7,285,456

The local dye production does not meet domestic demand. The manufacture of artificial indigo has been started, but production amounts to but 25 per cent of requirements. The production of dyestuffs during 1930, the last year for which figures are available, and imports during the past two years, are shown in the table. Japan has been shipping sulphur black to China since 1916, but during 1931 exports of 2,011,752 kilogs, valued at Y. 509,459 were small. During the second half of 1931 the Japan Dyestuffs Manufacturing Company showed a net profit of Y. 250,000 Earnings for other companies are not yet available, but it is believed that each of them made a fair profit. The factories are well equipped, experimental work is progressing, and the industry as a whole may be said to be in good condition, despite the depression.—*Chemical Trade Journal.*



A general view of the Completed Power House at Kokura

A New Japanese Power Station*

Large High-Speed Turbo-Alternators of British Manufacture

THE Kyushu Hydro-Electric Railway Co., Ltd., of Japan, not only supplies power and light to the chief industries of northern Kyushu, but is also interested in traction. Its electric lines already connect five towns, and developments are proceeding in connection with fifty additional miles.

The company started operations in 1910 with a small steam station in which B.T.-H., American G.E., and Met.-Vick. turbo-generators were installed from time to time. Its new station, designed by Mr. Y. Hirose, the company's chief engineer, has been built at a much lower total cost than any other in the country, and it is expected to reduce generating costs below anything hitherto accomplished in Japan. The site is on the western seashore of Kokura City, in Kyushu, on land reclaimed by ash disposal from the old station. The concrete foundation raft is supported on piles driven down to the rock, and the steel structures were designed to resist earthquakes. The walls are of corrugated sheet steel, covered with wire netting and plaster.

The proximity of the main railway line facilitates coal transport. Fuel storage and handling equipment was supplied by the Ajikawa Iron Works, comprising wagon puller and tipplers, weighing machine, belt and bucket conveyers, skip hoist, reciprocating and screw feeders, and grab cranes, driven by a.c. 200-v three-phase motors supplied by the Mitsubishi Electric Works. A coal crusher and dryer are also installed.

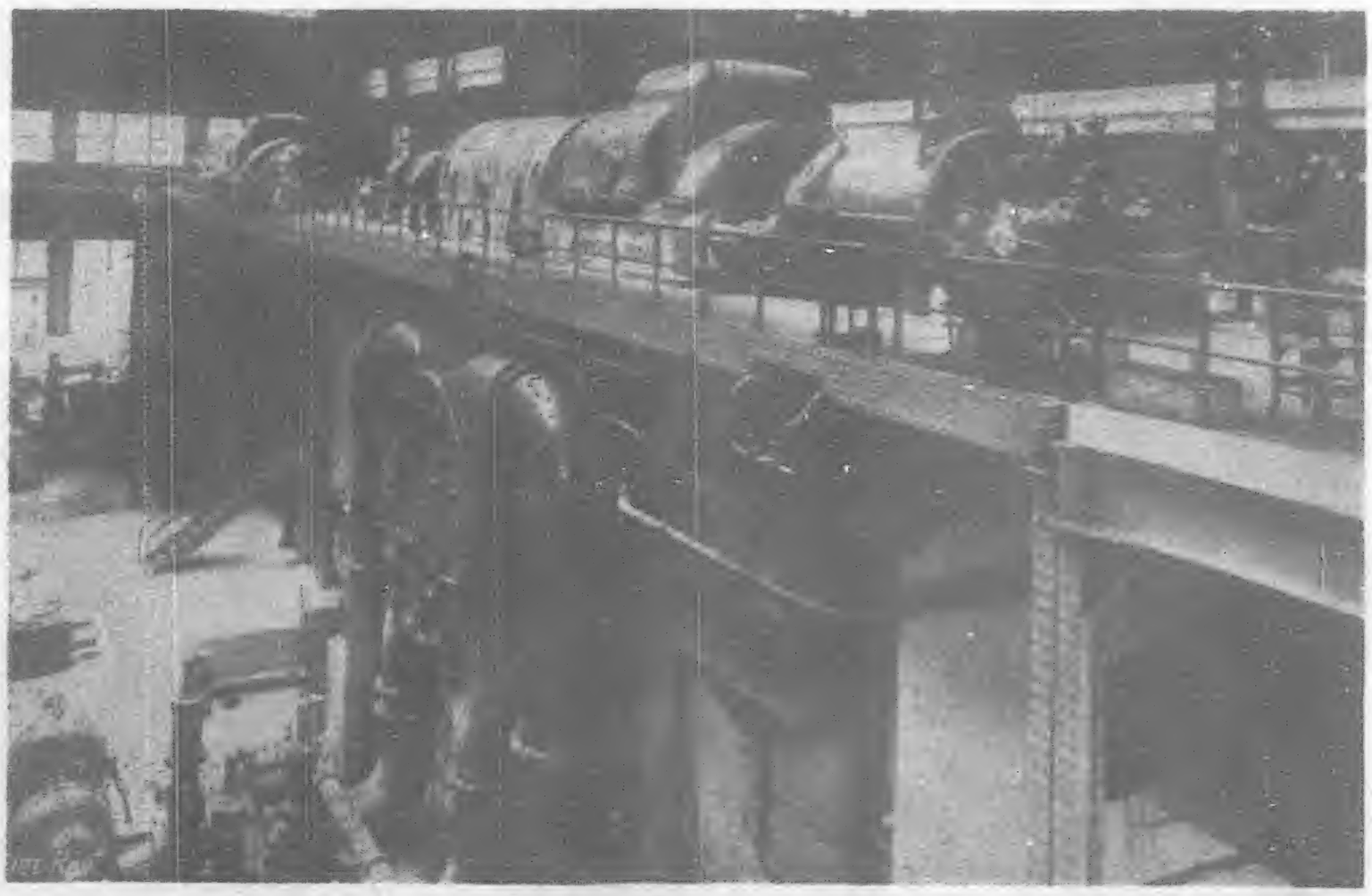
The Boiler Plant

The four Babcock & Wilcox boilers operate at a steam pressure of 37.5 kg. per sq. cm. and a temperature of 415 deg. C., normally evaporating 73,483 kg. per hour with feed water temperature of 149 deg. C. They are of the c.t.m. vertical header type, with a heating surface of 1,684 sq. m. and a superheating surface of 366 sq. m., the degree of superheat being 149 deg. C.

The "Aeolus" 175 h.p. forced and 380 h.p. induced draught fans, made by the Seki Co. (Tokyo), are driven by Shibaura 750-360 r.p.m. motors. There are four 387 b.h.p. four-stage centrifugal feed pumps; one is driven by a W. H. Allen & Sons' impulse steam turbine, and three by B.T.-H. 3,300-v three-phase motors. Each boiler is fired direct by its individual self-contained Fuller-Lehigh coal pulverizer, hot air from a B.&W. tubular preheater being induced into the mills to dry the coal. The furnace volume is 361 cu.m., and the Bailey water-cooled wall surface 199.7 sq. m. Each boiler has six "Calumet" turbulent burners, three B.&W. volute blowers, and three ball mills. A 375-w 125-v D.C. magnetic separator is installed.

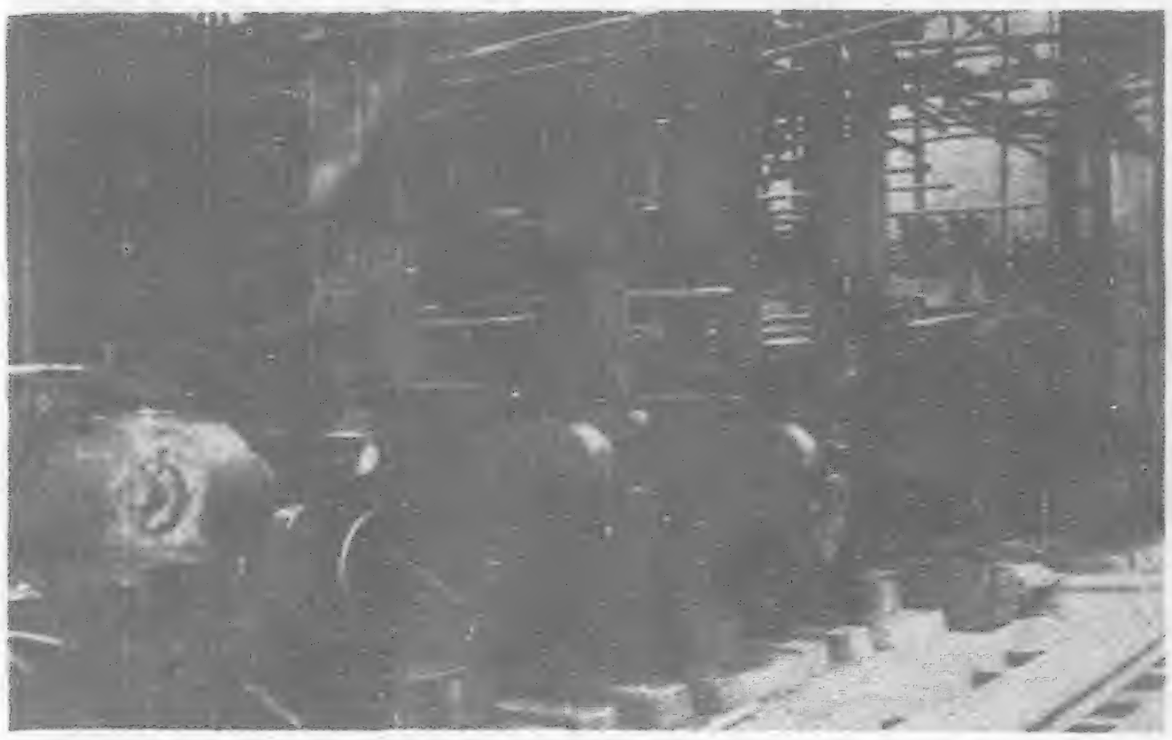
Ash is removed by the Allen Sherman Hoff process. The molten slag is tapped from the furnaces, broken into fine pieces by strong water jets, and removed by pump sluicing.

The flue gases are cleansed by "Pneuconex" plant. The larger particles of grit are caught in mechanical collectors, while the fine dust and fumes are washed out by high-pressure water sprays. The Bailey system of automatic combustion control has been adopted to ensure that powdered coal and air are mixed in the correct proportions for each boiler according to load variations. The whole of this equipment is electrically controlled, all the indicating instruments being arranged centrally. The operator also has remote control of the boiler auxiliaries in parallel with hand control.



The Engine Room showing the Condenser Basement

*From the *Electrical Review*



A Battery of Grinders in the Boiler Room

The Boiler House Control Floor

The Turbo-Generators

Each of the two steam turbo-generating sets comprises a 25,000-kw. main alternator and a 2,000-kw. house-service alternator, running at 3,000 r.p.m. (m.c.r.). They are stated to be the largest and highest speed machines installed in Japan so far, and were made by the Metropolitan-Vickers Electrical Co., Ltd. The Rateau-type turbines operate at a steam pressure of 35 kg. per sq. cm. and a temperature of 400 deg. C., exhausting into a vacuum of 28.5 in. Each has 20 h.p., 6 l.p., impulse, and two multiple exhaust stages. One lubricating pump, a "Vickeen" purifier, and three oil coolers per turbine are provided. The feed-water heaters are of the U-tube surface type with vertical centrifugal motor pumps and the evaporator is of the M.V. vertical low-pressure type.

The surface condensers have Sumitomo tubes; 150 h.p. circulating water and 50 h.p. extraction pumps, driven by 3,300-v three-phase motors, and steam-operated air ejectors with an intercooler. The cooling water screens were made at the Ishikawajima dockyard. For minimising condenser corrosion there is a 220-v three-phase motor-generator set, with a 2 kw. D.C. output of 200A at 10-v.

Coupled in line all directly to each turbine are one main (25,000 kw. m.c.r. 11,000-v) and one house-service (2,000 kw. m.c.r. 3,050-v) 50-cycle, 0.8 p.f., three-phase star alternators of 12 and 16 per cent inherent reactance respectively; together with a shunt wound, double armature, common yoke 133 kw. 350-v main exciter (which is, in turn, excited by a 0.91 kw. 360-v magnet excited machine connected by 3,000-1,260 r.p.m. gear to the main alternator) and a self-exciting 24 kw. 130-v house-service set exciter.

Water-cooled air is circulated round the closed ventilating circuit, and fire protection is afforded on the "Alfite" time-delay CO_2 system. A complete Mitsubishi electrical protective system has been provided, with automatic telephones, coloured signal lamps and alarm devices in the central control room, including temperature indicators for the principal generators, transformers and motors.

The main generators are connected direct to 10,500-kva. 11/22-kv. transformer, single-phase, delta-delta connected. There are seven, three per machine, with one spare. The double bus-bars and switchgear are on the high-voltage side of the transformers. The reinforced concrete cellular construction separates the phases, and non-magnetic barriers minimise stray fields and inductive heating. The main circuit breakers are of the single-pole solenoid-operated compartment type for 1,200 A at 22,000-v, with a breaking capacity of 600,000 kva. All transformers and switchgear are of Mitsubishi manufacture.

In the event of the supply voltage falling below a predetermined limit the house-service circuit will be automatically changed over from the generators to the transformer bus-bars and thus maintain the auxiliary services.

There is an Ajikawa electric travelling crane and an American Otis lift; Electroflo steam instruments are used, and Kent, Negretti, Siemens, Kelvin, Cambridge, and Bailey boiler instruments have also been installed.

The power generated is transmitted a distance of 400 meters to a sub-station by a double underground circuit of 62,500 kva. capacity with a third spare circuit. The cables operate at 22,000-v and are of the Emanueli oil-filled type, of 322 sq. mm. sectional area, paper insulated, double lead sheathed, reinforced with hard copper tape and jute yarn covered. They are the first of their kind to be used in Japan, and were made by the Sumitomo Co. The cables are laid in a concrete trough, which is filled with pitch to exclude sea water.

Manchukuo Aviation Company

A plan has been worked out to establish Manchuria Air Transportation Company under joint Manchukuo-Japanese management. The company will establish two air routes within the current year, one linking Dairen with Mukden and the other having Shingishu, Korea, and Tsitsihar, Heilungkiang Province, as its termini with Mukden, Hsinking and Harbin as intermediate stations.

The statement issued by the War Office in this connection read as follows:

"It is desired by every person that a European-Asiatic main air route be established by linking the Soviet Far Eastern air route—from Moscow to Irkutsk—with the Japan Air Transportation Company's Tokyo-Dairen route. The convenience of traversing the vast plain of Manchuria by air is similarly recognized by every person.

"In view of the fact that a regular air service between the various places in Manchuria will contribute greatly to the development of industry and the promotion of culture, such an enterprise had been the subject of study until recently when a plan was worked out to establish a Manchuria Air Transportation Company.

"The Manchuria Air Transportation Company is to be financed by the Manchukuo Government, the South Manchuria Railway and the Sumitomo Goshi Kaisha as a service to the public and is a joint-stock company to be placed under joint Manchukuo-Japanese management. The company is to be registered with the Manchukuo Government.

"Although a joint-stock company, the Manchuria Air Transportation Company will receive positive assistance from the Japanese Government and the South Manchuria Railway and is to be regarded as a juridical person for the public benefit. The company will pay no dividend for the time being.

"The principal business of the company is regular air transportation and within the current year, two air routes are scheduled to be established, one linking Dairen with Mukden and the other having Shingishu, Korea, and Tsitsihar, Heilungkiang Province, as its termini with Mukden. Hsinking and Harbin as intermediate stations. The air routes will be increased gradually.—*The Japan Times.*

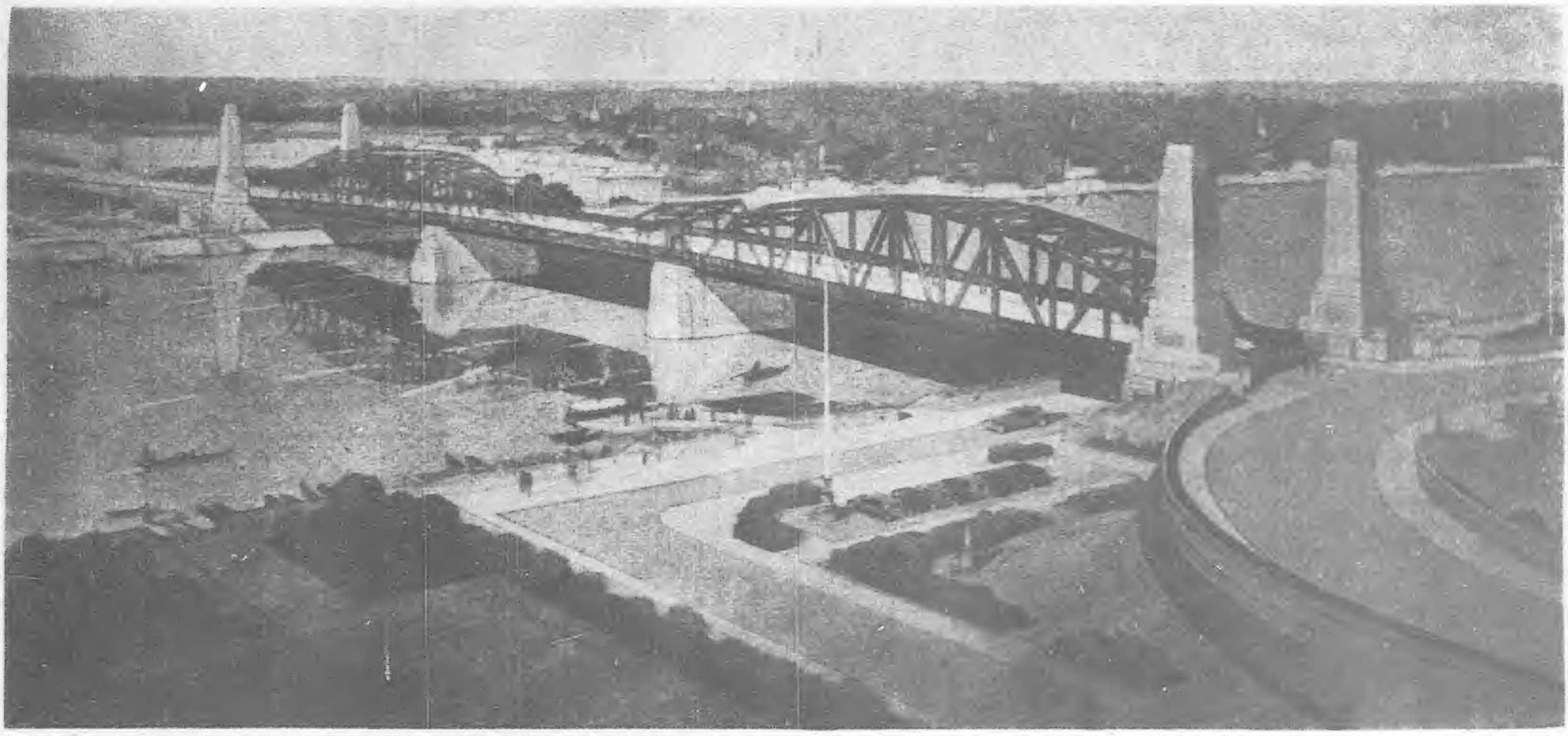


Fig. 1.—Architect's Proposed Lay-Out of Bridge

The Bangkok Memorial Bridge*

Structure Over River Chao Phya Designed and Built by Messrs. Dorman, Long and Company Commemorates Founding of Capital of Siam

THE Bangkok Memorial Bridge commemorates the founding of the Royal City of Ratana Kosindra (Bangkok), the present capital of Siam. The city was founded on the left bank of the river Chao Phya by King Phra Buddha Yodfa, the first sovereign of the Royal House of Chakri. On the right bank lies Dhonburi, the old capital of Chao Tak Sin. Development on this side of the river has been much hampered for want of direct communication with the new city. It was with the object of promoting the development of the right bank that the authorities decided that the National Memorial should take the form of a road bridge providing direct communication between the two cities.

Representatives from prominent bridge-building firms throughout the world—from America, Denmark, France, Germany, Italy, and Great Britain—were invited to visit Bangkok in 1928, where the scheme for the bridge project was placed before them. They were invited to prepare designs and to furnish estimates for the whole of the work, including the bridge and its approaches. The Siamese specification laid down the general requirements as to the carrying capacity of the bridge, the clear openings and head-room required, and the lay-out of the approaches and architectural treatment. In all other respects, the design was left entirely in the hands of the tenderers. The supervision of the engineering work was entrusted to Messrs. Sandberg, consulting engineers to the Royal State Railways of Siam. In the summer of 1929 the contract for the work was placed with Dorman, Long and Co., Ltd., of Middlesbrough, at a price of £255,141.

The works comprising the contract were subdivided into six main divisions :—

(1) The bridge proper.
(2) East approach viaduct and embankment.
(3) West approach viaduct and embankment.
(4) River wall and stairways.
(5) Pontoon landing stages.
(6) Architectural treatment.

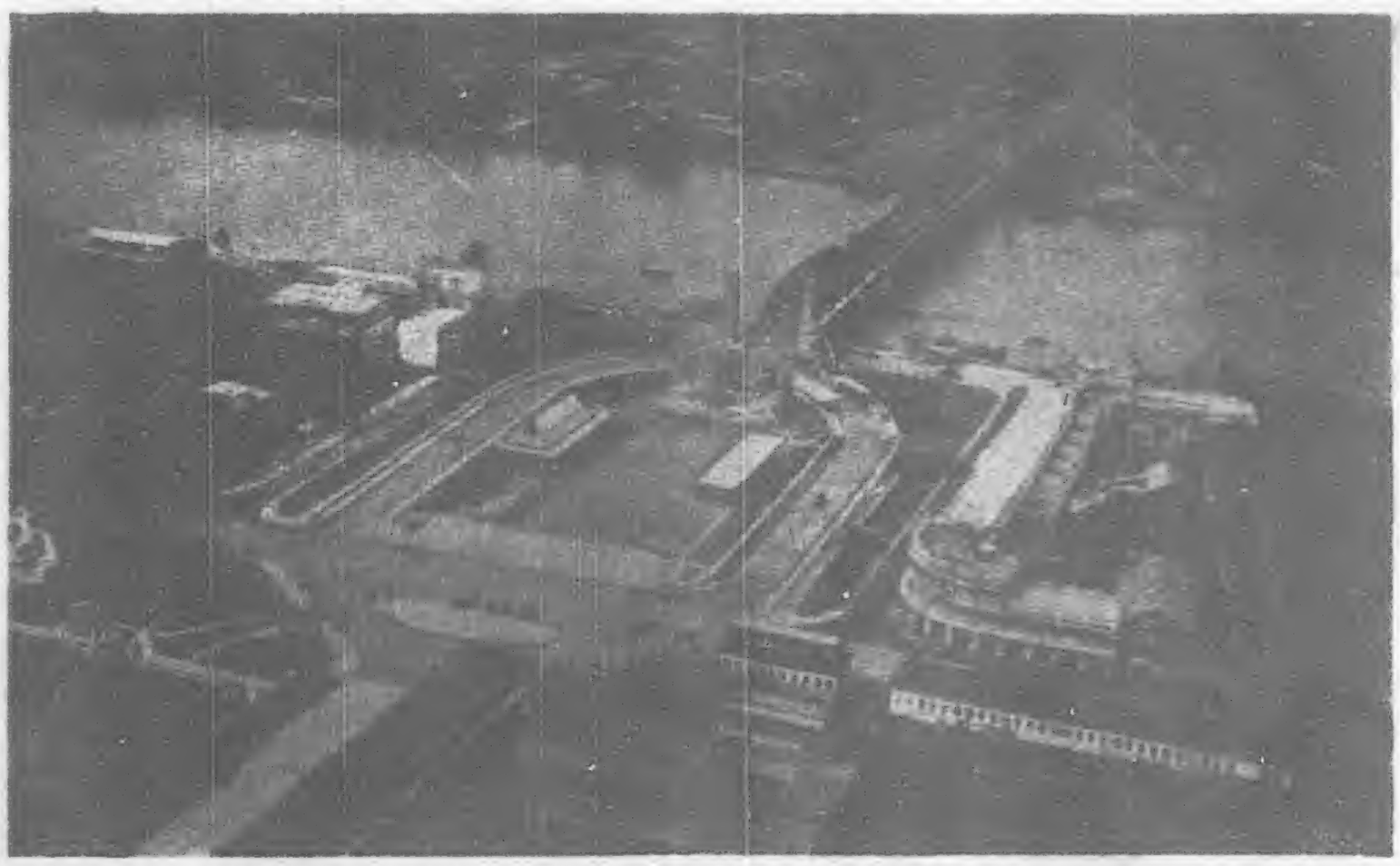


Fig. 2.—Aerial View of Completed Bridge and Approaches

The river crossing, 750-ft. wide between faces of abutments, is divided into three main openings. The two side openings of 247-ft. each are covered by fixed through-type steel lattice girders. The central opening of 196-ft. is spanned by a double-leaf bascule, electrically operated. The river ends of the side spans and the bascule spans are supported upon large piers with caisson foundations, 98-ft. below mean water level. The shore ends of the side spans are supported upon abutments

*The Engineer.

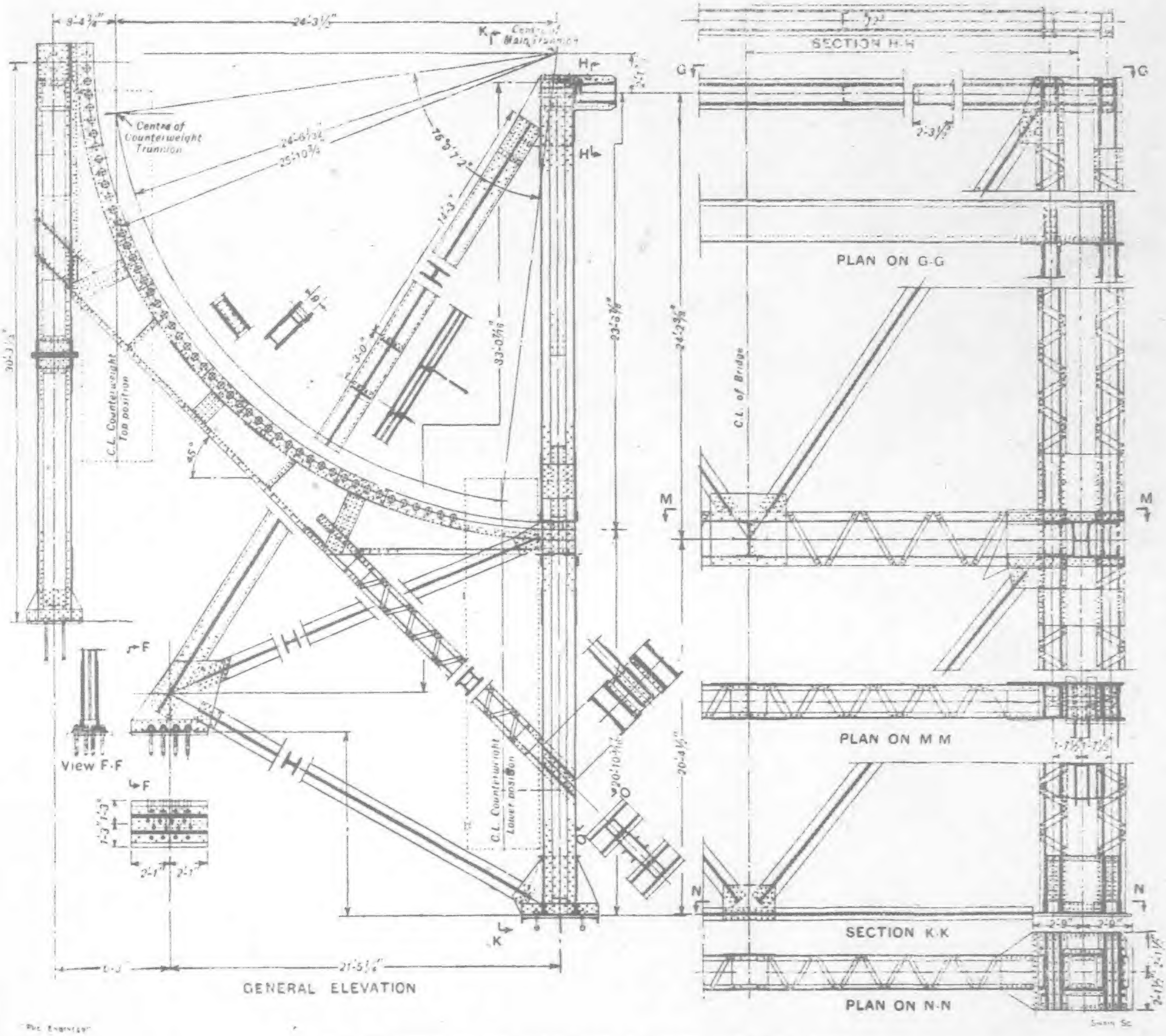


FIG. 3—DETAILS OF STEEL FRAMEWORK WITHIN THE RIVER PIERS

founded upon reinforced concrete piles. The east approach consists of a U-shaped reinforced concrete viaduct, upon piled foundations, leading down from the bridge deck. Beyond the end of this viaduct the two approach roads are brought down to ground level upon earth-filled embankments supported by concrete retaining walls. The same construction is adopted for the west approach, but in this case only a single approach road leads on to the bridge. The river frontages upon both sides of the river for a length of 400-ft. are protected by reinforced concrete sheet piling, tied back to anchor piles and capped by a concrete coping and balustrade. Stairways are provided at intervals giving access to the water. Four steel landing pontoons, 33-ft. by 16-ft., are anchored in front of the river wall, guided between piled dolphins and connected to the shore by short steel bridges.

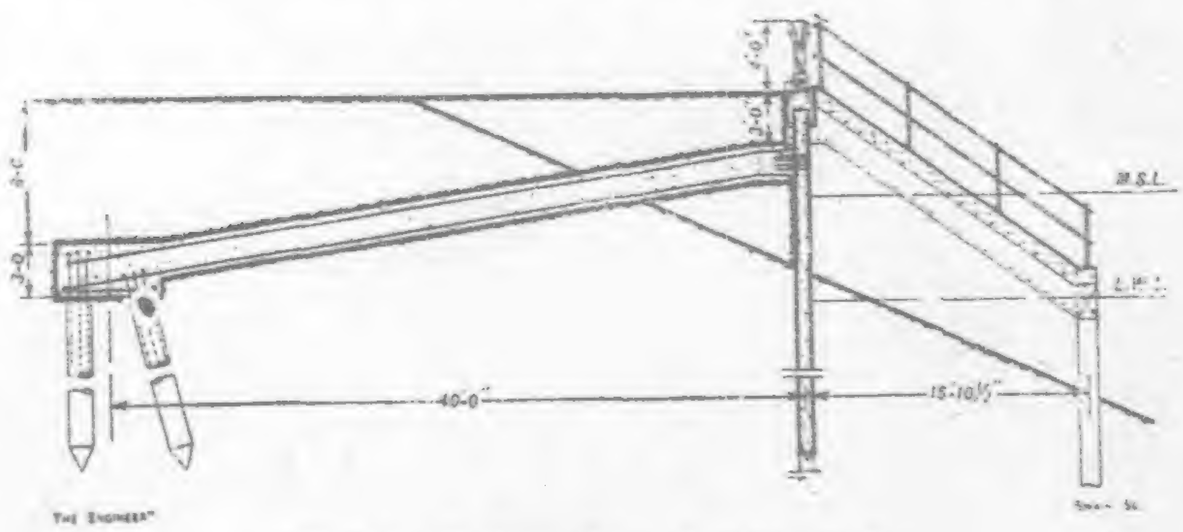
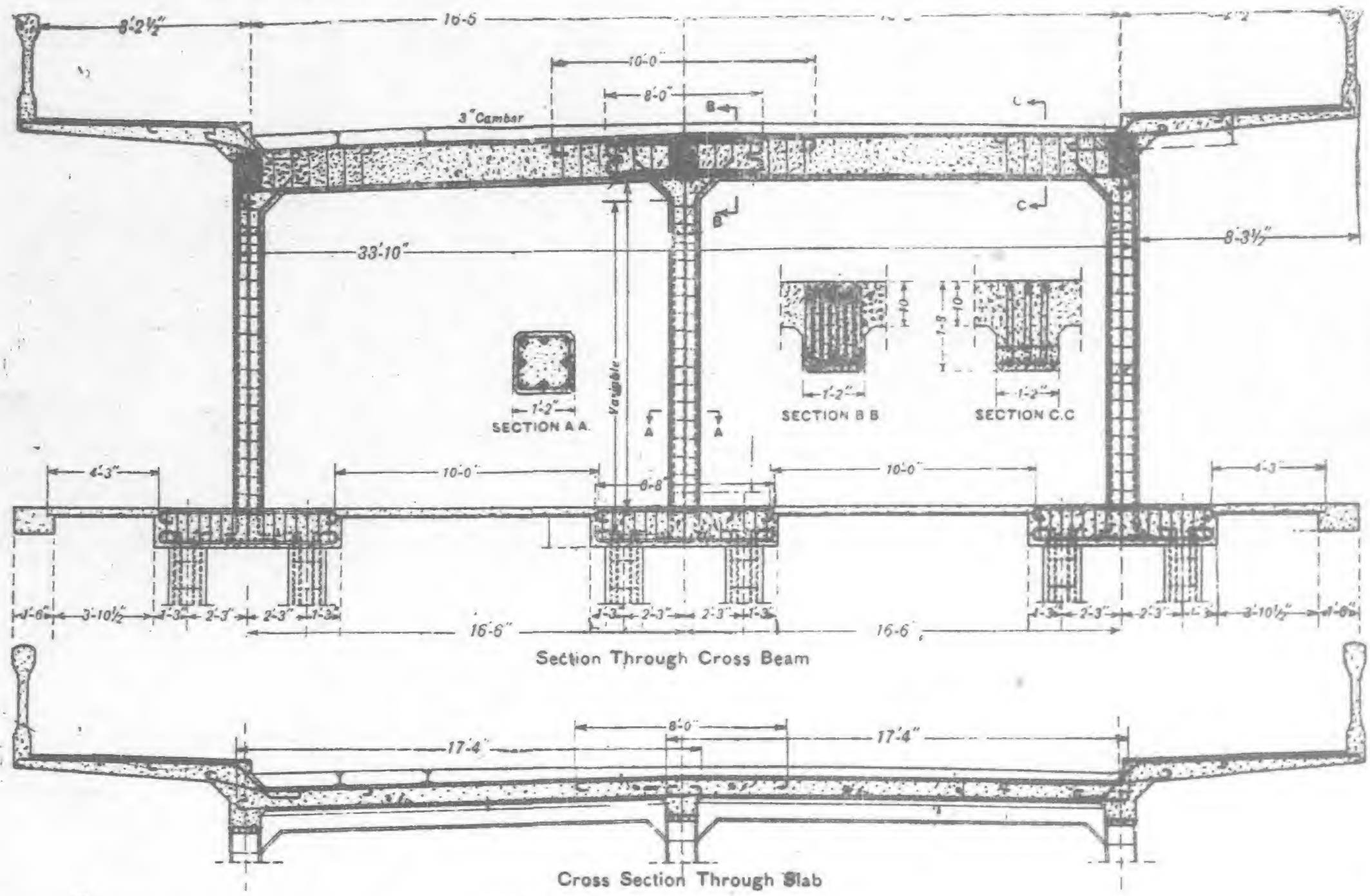


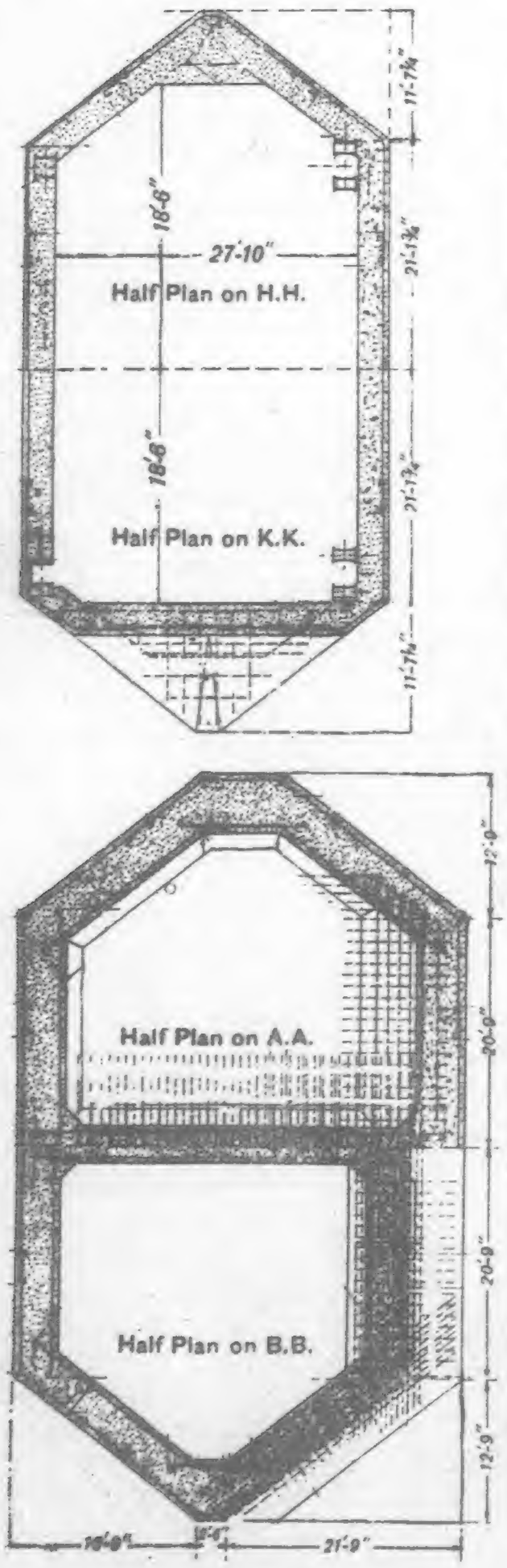
Fig. 4.—Section through river wall

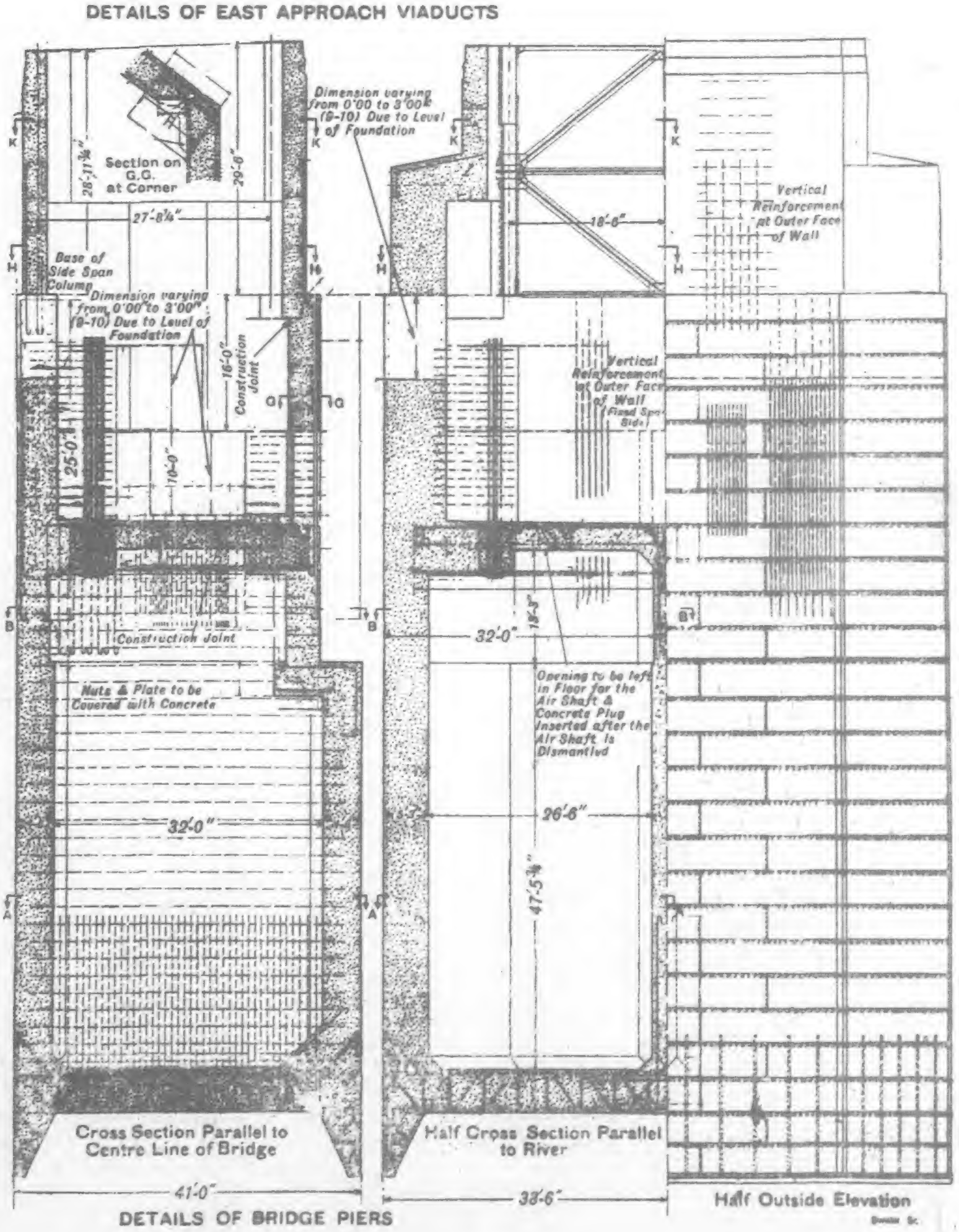
The architectural treatment included the provision of four large reinforced concrete pylons, 60-ft. high, immediately behind each of the bridge abutments, flanked by stairways leading from the bridge deck to the ground below. Other flights of steps were provided connecting the deck of the east approach viaduct with the area enclosed between the two arms of the approach. The full architectural proposals outlined in the contractor's offer and prepared for them by Sir J. Burnet and Partners, included the laying out of gardens within this enclosure and the construction of awnings projecting from either side of the approach viaducts below which shops would be constructed. The actual memorial is situated on the axis of the bridge at the apex of the space enclosed between the two arms of the east approach. The architects' proposed layout is shown in Fig. 1, and in the

THE BANGKOK BRIDGE

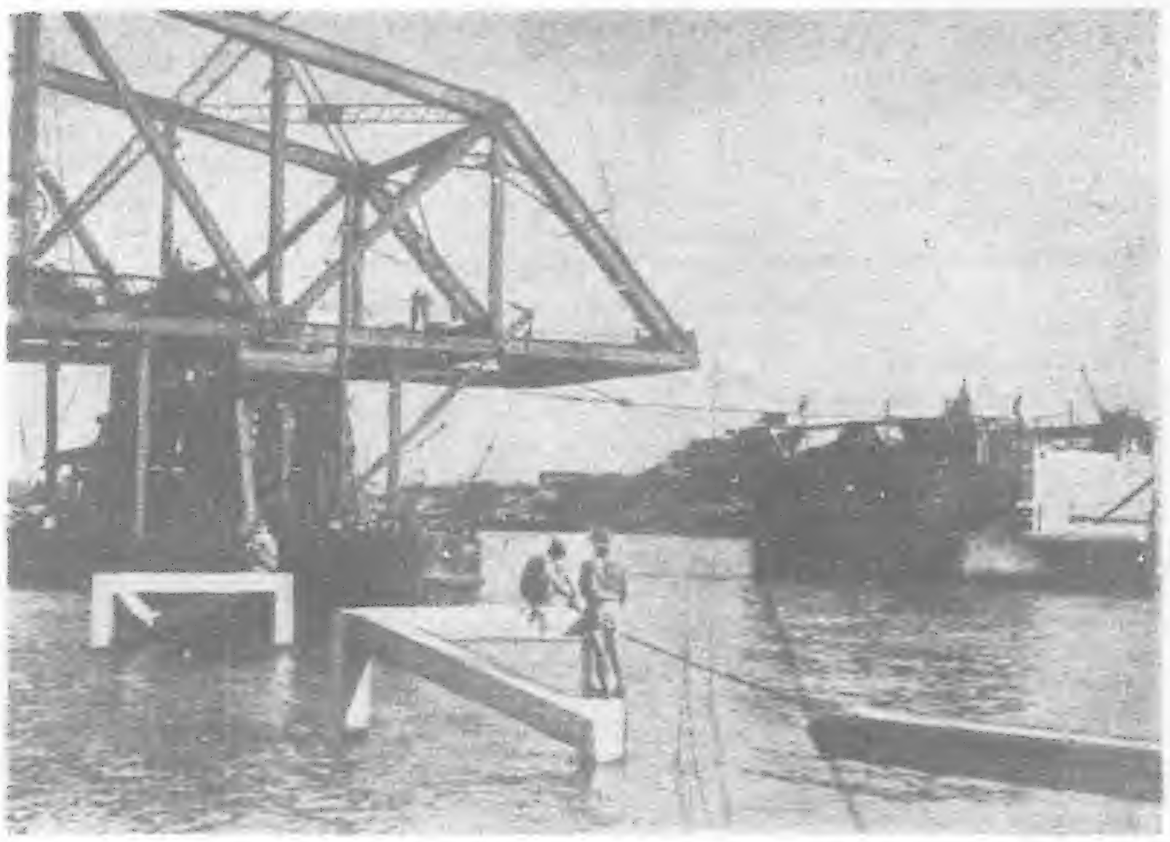


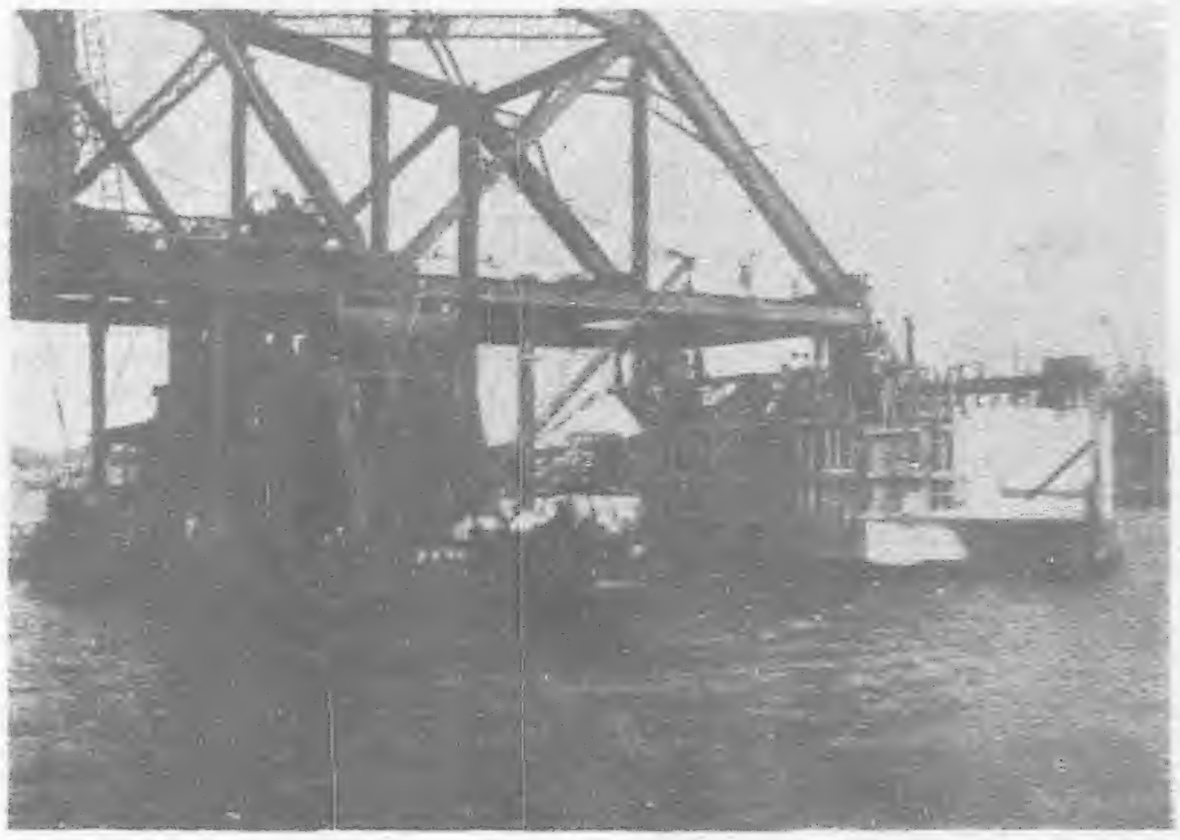
DETAILS OF EAST APPROACH VIADUCTS





DETAILS OF BRIDGE PIERS





Figs. 5 and 6.—Launching the East Span

photograph reproduced in Fig. 2 the completed bridge can be seen.

The bridge and approaches accommodate a roadway, 33-ft. wide between kerbs, with cantilevered footwalks, 8-ft. 3-in. wide on each side. Provision is made for carrying a double tramway track across the bridge, but this track has not yet been constructed. The bridge also carries a 20-in. diameter water main under one footway, special provision being made for "breaking" this pipe line during the operation of the bascule span. The approaches are graded up at three per cent to the bridge abutments with gradients of 2.36 per cent on the side spans, to give a clear headroom of 24-ft. 6-in. above mean water level under the steel work of the bascule span. The design was prepared, in accordance with the British Standard Specification, to provide for modern heavy highway traffic. British steel, rolled and fabricated in Middlesbrough, was used throughout the construction of the bridge.

The Bridge Proper

Side Spans.—The side spans are supported by through-type steel lattice girders with Warren bracing, 247-ft. span center to center of bearings, divided into ten panels of 24-ft. 8-in. The trusses have a maximum depth of 37-ft., with curved upper chords. Complete top and bottom lateral bracing is provided throughout with effective sway bracing on intermediate verticals and portals on the end rakers. The roadway deck is of reinforced concrete, 6-in. thick, surfaced with 1½-in. of asphalt. The roadway slab is carried by eight lines of steel joist stringers framed into plated cross girders. The footway decking is formed of a 3-in. reinforced concrete slab surfaced with 1-in. of asphalt carried on steel stringers resting upon brackets cantilevered from the ends of the main cross girders. Ornamental wrought iron parapets are provided on both footways. Cast steel sliding bearings are included to allow for expansion at the shore ends of the spans, which are fixed at the river end in the main piers.

Central Span.—The central opening of 196-ft. is covered by a double-leaf bascule span supported by through lattice girders. The length of each river leaf center to center of intersections is 101-ft. 6-in. and the length of the anchor arm 24-ft. 8-in. Each river leaf is divided into five panels of 20-ft. 3½-in. Complete bottom bracing is provided throughout. The roadway clearance only permits of transverse bracing between the upper chords over the main trunnions. The bascules are of the fixed trunnion type, and are counterweighted by massive cast iron counterweights in steel boxes, suspended by links hinged to the ends of the anchor arms. The counterweights and the whole of the operating machinery are contained in watertight chambers constructed in the river piers and are completely invisible from the river or the bridge deck.

Under dead load the bascule leaves and their counterweights are in perfect balance about the main trunnions for all positions. When the leaves are in the down position, the tails of the bascules are locked by means of bolts to the columns supporting the approach spans, while the noses of the leaves at the center of the opening are connected by a shear lock, so that under live load each leaf is in the condition of a cantilever with its outer end freely supported upon the adjacent bascule.

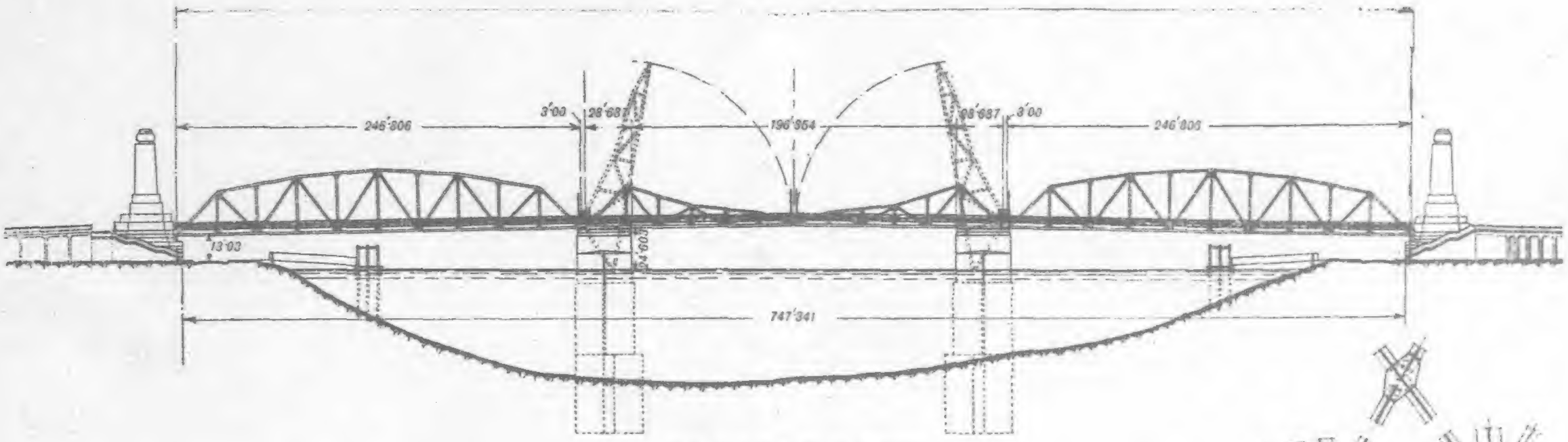
The deck of the bascule span is of hardwood timber. On the roadway a longitudinal layer of 3-in. timber rests upon 8-in. by 6-in. transverse transoms spaced 24-in. center to center. The footways are decked with 2-in. planking laid on steel longitudinal stringers. The roadway deck is carried by eleven lines of steel joist stringers framed into plated cross girders. Cantilever extensions of these cross girders support the footway stringers. Ornamental wrought iron balustrades are provided on both footways. The roadway is carried by the bascule trusses for the full length of the anchor arm. The footway decks, however, are interrupted at the face of the pier, and the footways are carried upon the piers themselves in order to allow the anchor arm of the span to enter the pier when the leaf opens.

The bascule leaves rotate about forged steel trunnions which are supported upon a steel framework enclosed in the main river piers. The details of this framework are shown in the drawing reproduced in Fig. 3. The front main columns of this framework carry the reaction from the bascule trunnions down to concrete pedestals upon the solid floor of the machinery chamber in the pier. A second pair of columns at the shore side of each pier, supports the ends of the fixed approach spans. The front and back columns in each pier are connected by structural steel pin racks with which the main driving pinions of the bascule leaves engage. The outer halves of the front main trunnion columns are braced by steel rakers from the floor of the machinery chamber. Both the pairs of front and back columns are connected transversely by rigid bracing. Owing to the desire to restrict the size of the piers to the minimum, so as to avoid undue obstruction of the river, the space available in the piers for the accommodation of the tails of the bascule spans and the machinery counterweights and supporting steel work was extremely limited, and the greatest care was necessary in detailing this work to ensure sufficient clearance at every point.

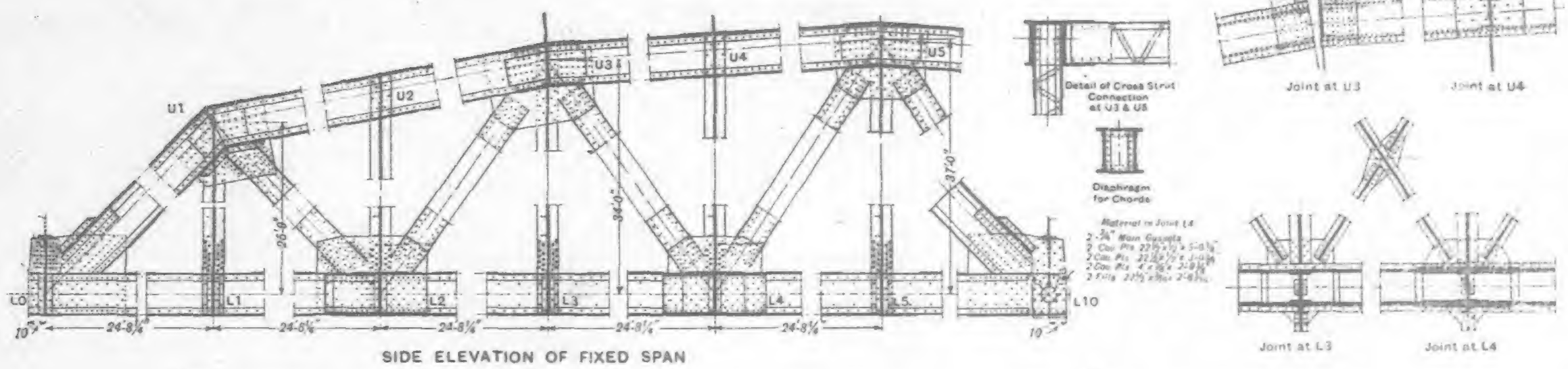
The bascule leaves are electrically operated, and auxiliary petrol gear is provided in case of failure of the electric supply. The machinery, which was supplied by Thos. Broadbent and Sons, Ltd., of Huddersfield, is mounted on the underside of the tails of the bascule spans. The electrical supply available is three-phase, 175-volts, 50-cycles. The main turning motors are each of 50 h.p. They drive through a train of spur and worm reduction gearing to the main driving pinions situated at the ends of the anchor arms, which engage with the pin racks mounted on the pier steel work. Solenoid brakes capable of holding the span against a wind force of 10 lb. per square foot are provided on the motor extension shaft, while an additional brake of clip type mechanically operated is mounted on the second reduction shaft, capable of holding against a wind pressure of 20 lb. per square foot. The two brakes acting together are designed to hold the span against a force of 30 lb. per square foot in the open position.

Locking bolts are provided at the center and tail ends of the bascule span and are driven through suitable gearing by electric

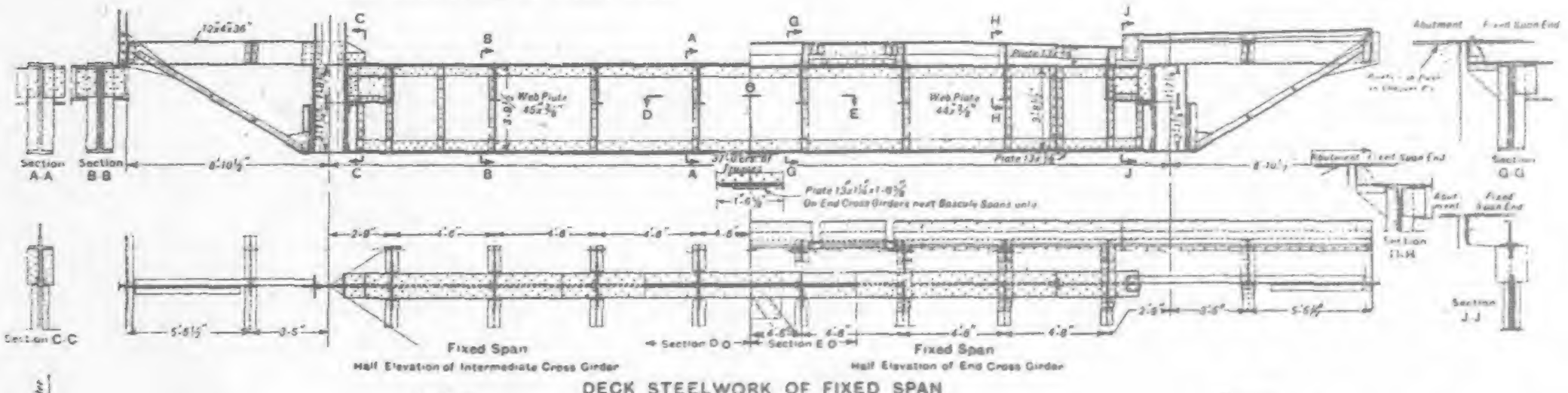
THE BANGKOK MEMORIAL BRIDGE



SIDE ELEVATION OF BRIDGE

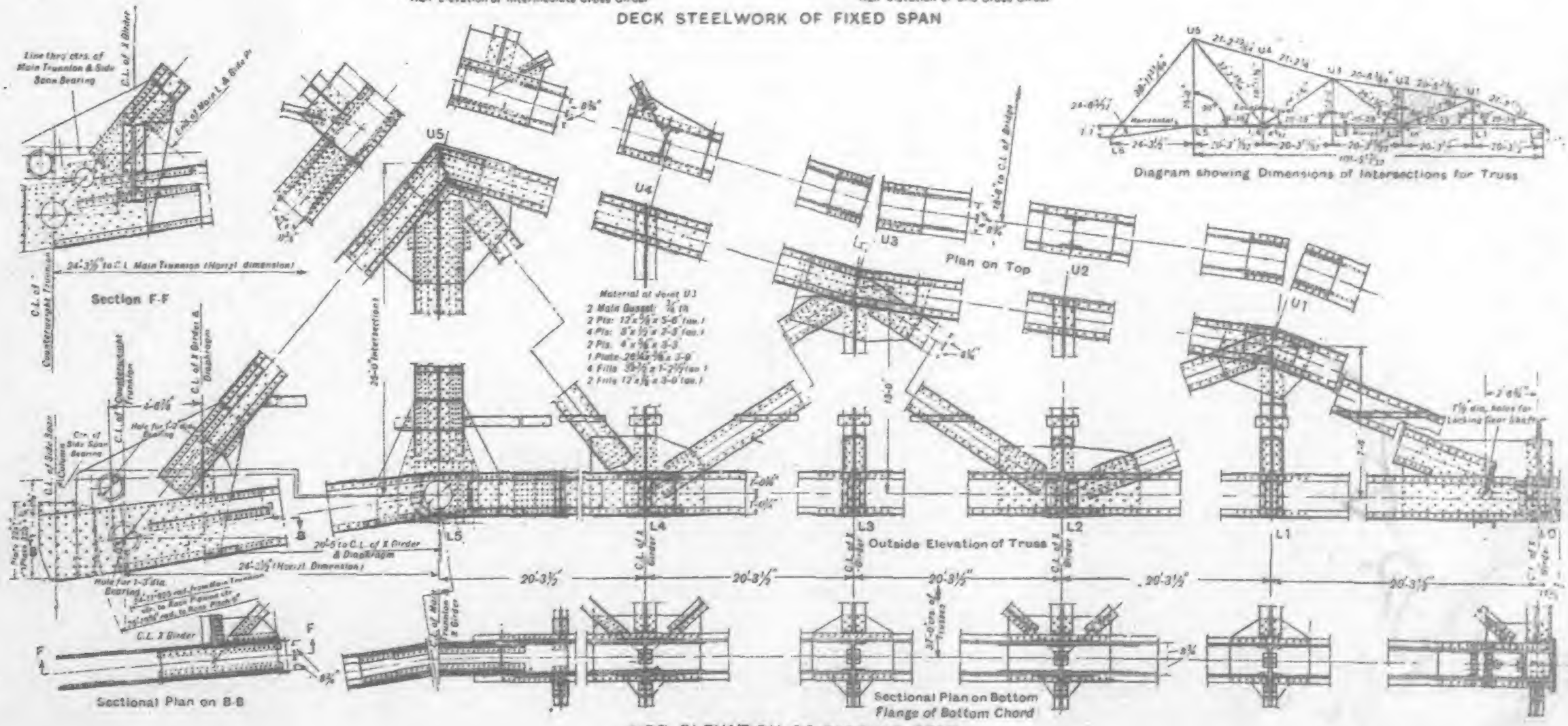


SIDE ELEVATION OF FIXED SPAN

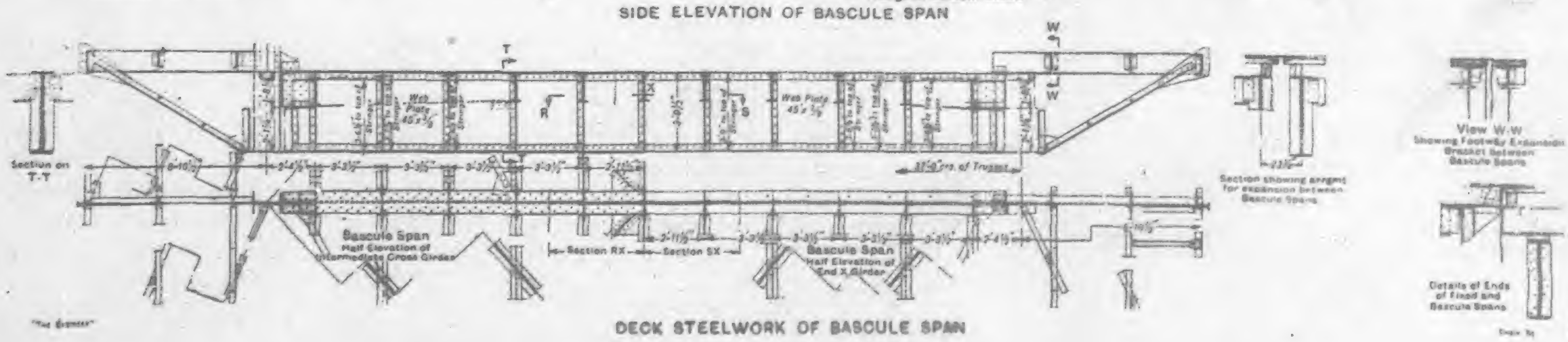


Half Elevation of Intermediate Cross Girder — Half Elevation of End Cross Girder

DECK STEELWORK OF FIXED SPAN



SIDE ELEVATION OF BASCULE SPAN



DECK STEELWORK OF BASCULE SPAN

motors of 2½ h.p. and 5 h.p. respectively. In each case a single motor controls the lock on both trusses through a cross shaft running the full width of the bridge. Provision is made for hand operation in both cases in the event of electrical failure. The travel of the locking bolts is controlled by solenoid brakes and limit switches. Auxiliary power is provided for the main turning gear in the form of a petrol driven motor mounted on the span and connected with the main reduction gearing by means of a clutch. The electrical gear is designed to open or close the bridge against a wind force of 10 lb. per square foot in five minutes; fifteen minutes are required with the auxiliary gear. Swing barrier gates are provided across the road and footways at the river ends of the fixed spans. They are interconnected with the operating gear of the bascule leaves. The whole of the control gear is situated in a cabin on one of the piers at bridge deck level. Completely automatic electrical control from a single master controller is provided, all operations being performed in the correct sequence by moving over the handle of the controller. Warning lights and indicators in the cabin indicate the actual progress of operations. The two piers are connected by a submarine cable carrying the power supply. Contactor gear and resistances are situated in separate chambers arranged inside the piers.

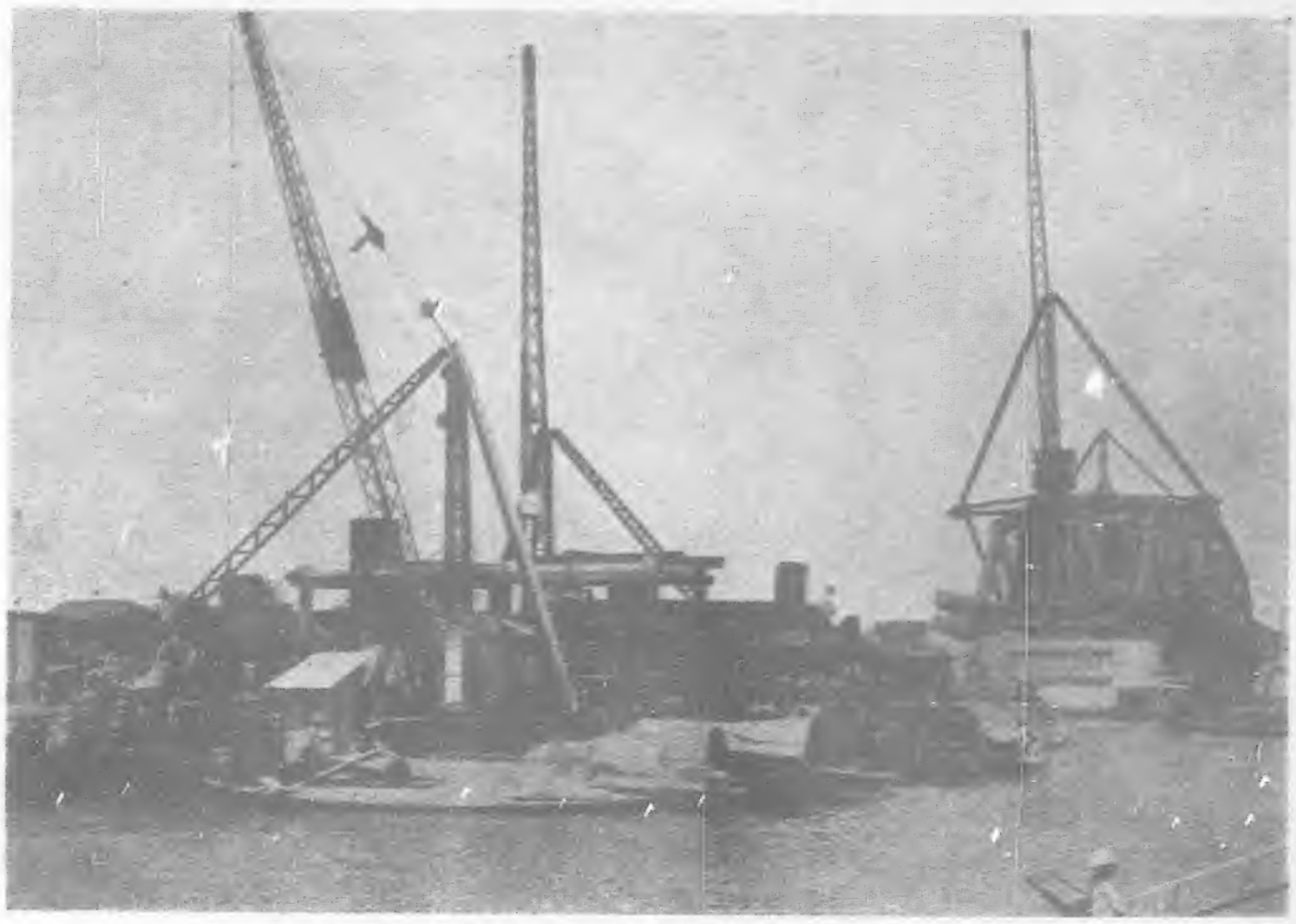


Fig. 7.—Sinking of the West Caisson and Erection of Piers

A 20-in. diameter water main is carried under one footway of the bridge. Special gear is provided for disconnecting this main at the center of the bascule opening, interconnected with the main operating gear. The water main rotates from trunnions situated upon the axes of the main bridge trunnions on the piers.

River Piers.—The East and West river piers are founded 98-ft. below mean water level and penetrate approximately 45-ft. and 30-ft. into the river bed respectively, both piers being founded on blue clay.

The piers are constructed as hollow reinforced concrete shafts founded on steel caissons filled with mass concrete. They were sunk by the pneumatic process from floating plant moored in the river. The maximum air pressure required during sinking was 45 lb. per square inch. The general construction of the piers is shown in the drawings reproduced herewith, while another illustration, Fig. 7, shows work in progress on the sinking of one of them. At the cutting edge the steel caissons measure 67-ft. long by 41-ft. wide. The working chambers were 8-ft. high from cutting edge level. Two air shafts and locks were provided. The piers are tapered at the up and downstream ends. A solid concrete slab 5-ft. thick covers the roof of the working chamber and encases the steel roof girders. Above this level two large voids are formed in the pier, divided by a central cross wall. The external walls are 4-ft. 6-in. thick; 20-ft. below mean water level the voids are roofed over by a heavily reinforced concrete slab 3-ft. thick. Above this slab the central cross wall is omitted and the space inside the pier utilized to form a watertight counterweight chamber. Concrete bases are provided for the steel work supporting the bascule trunnions and approach span bearings. The spaces at the up and downstream ends of the pier are utilized to accommodate the resistances and contactor gear for the bascule span. Permanent steel shell plating was provided for the sides of the piers up to low-water level. To accommodate the varying reactions from the bascule and fixed spans, the tops of the piers are placed excentrically upon the bases so as to improve the distribution of load upon the foundations. There is thus a step 5-ft. wide on the river side of each pier. A scarcement varying from 9-in. to 1-ft. 9-in. wide is provided near low-water level to allow for errors in pitching the caissons. The average pressure on the foundation allowing for the effect of buoyancy does not exceed 2¼ tons per square foot, and effect of wind and excentricity of loading does not increase the pressure above 2¾ tons per square foot.

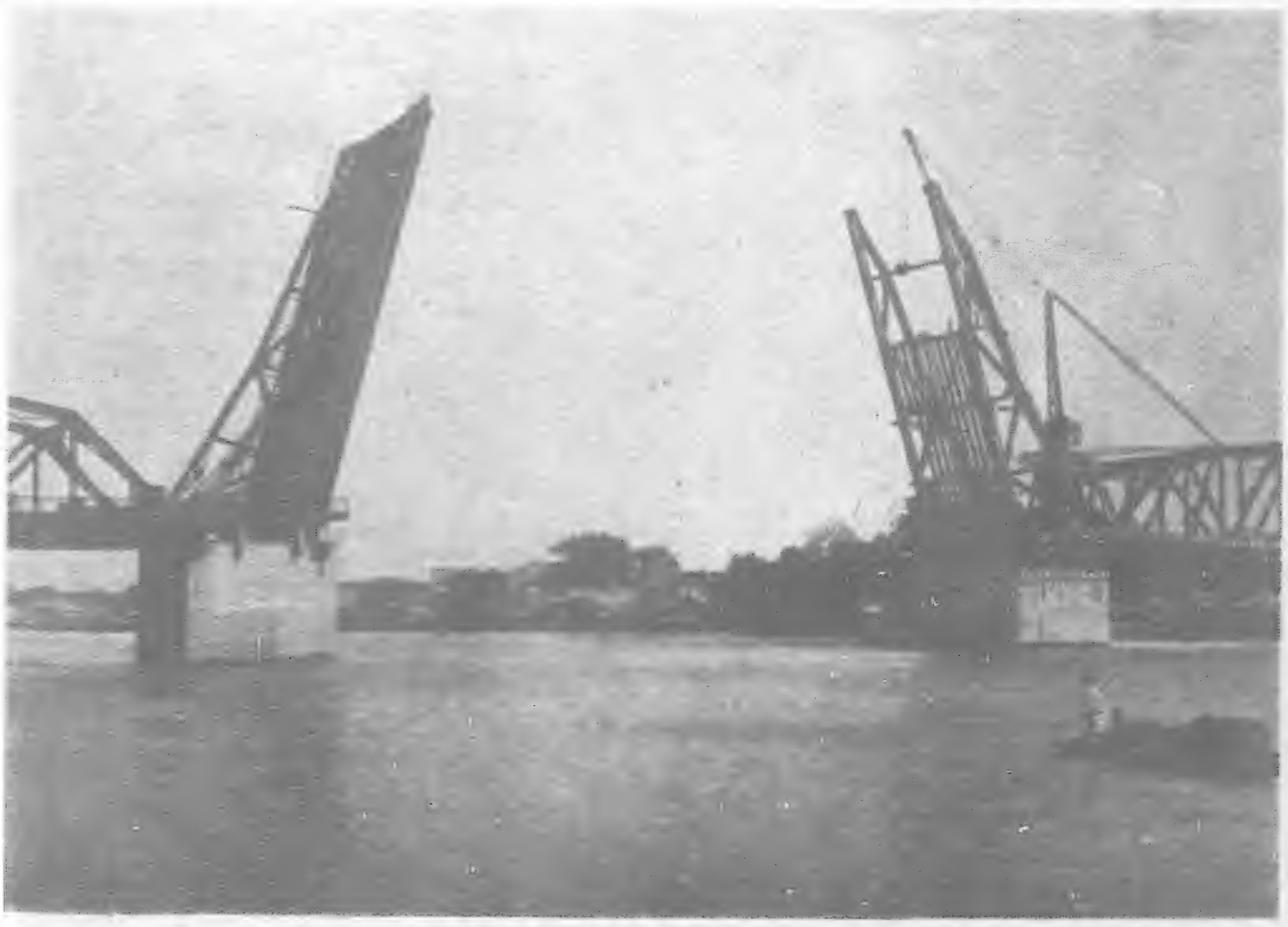


Fig. 6.—Erection of Bascule Span

Abutments.—The abutments are founded upon groups of fifty-three 17-in. diameter Vibro piles 56-ft. 6-in. long, reinforced with six ¾-in. diameter steel rods. The piles are capped with reinforced concrete slabs 4-ft. thick, measuring 54-ft. by 16-ft., upon which the abutment walls are built up in mass concrete. The abutment itself takes the form of pilasters approximately 8-ft. square under the end bearings of the approach spans connected by a wall approximately 5-ft. thick upon which the ends of the approach viaducts are supported.

Bridge Approaches

The portion of the approach adjacent to the abutments on both sides of the river consists of a reinforced concrete viaduct supported upon 17-in. diameter Vibro piles 56-ft. long. The viaduct consists of bents of three columns spaced at 16-ft. 6-in. center to center, the spacing between bents being 15-ft. Each column is supported by two Vibro piles, capped with a small reinforced concrete slab. The whole area between the pile caps is covered with a

4-in. reinforced concrete slab. The columns are connected transversely and longitudinally by reinforced concrete beams supporting the 10-in. deck slab. The footway brackets are cantilevered out beyond the outer rows of columns and support reinforced concrete balustrades. Cross-sectional arrangements can be seen on the opposite page. The viaduct extends backwards for a distance of 257-ft. behind the abutment center line on the West approach, and for approximately 177-ft. measured parallel to the bridge center line on the East approach. The viaduct on the East approach is in the form of a U of 139-ft. radius connected to the end of the approach span at its apex by a reinforced concrete deck supported on columns of similar construction to the remainder of the viaduct.

From the shore ends of the viaducts on both river banks the approach roads are carried down to ground level upon earth filling supported by concrete retaining walls. The total length of the East approach is 534-ft. 9-in., and of the West approach 567-ft. 9-in., measured backwards from the face of the river wall.

River Wall and Stairways.—For a length of approximately 197-ft. on either side of the bridge center line both river banks are protected by a reinforced concrete sheet pile retaining wall anchored back at intervals of 18-ft. to clusters of three 17-in. diameter Vibro anchor piles situated 40-ft. behind the face of the wall. Two piles in each cluster of anchor piles are driven on a rake of 1-ft. 4-in. The wall itself consists of precast piles 12-in. by 16-in., 29-ft. 6-in. long. Every sixth pile acts as a king pile and is made 58-ft. long. Piles are keyed together by 1½-in. bore gas tubes inserted in grooves between them. Each pile is attached by steel stirrups to a reinforced concrete beam cast along the back of the wall in which the ends of the anchorages are embedded. The arrangement is shown in Fig. 4. Openings are provided in each wall at two points for stairways, giving access to the water for small boats and at two further points for gangways giving access to floating landing stages. The ends of the walls are returned for a length of 10-ft. as a protection against scouring behind the walls. The tops of the sheet piles are capped with a reinforced concrete coping carrying a moulded concrete balustrade.

Pontoon Landing Stages.—Two floating landing stages, consisting of steel pontoons approximately 33-ft. by 16-ft., are provided on each side of the river. The pontoons are guided between dolphins of three reinforced concrete piles at each end, and are approached by steel bridges, approximately 57-ft. long, pivoted to accommodate the rise and fall of the river. The pontoons and their approach bridges are decked with timber.

Erection Procedure

Sinking of River Piers.—The river piers were sunk entirely from floating plant moored in the river, which has a current as high as six m.p.h. Two floating pontoons, each measuring 100-ft. by 30-ft., were used for the purpose, carrying the necessary plant, cranes, compressors, mixers, etc., required during the sinking operation. The steel working chambers were built up ashore, launched and floated into position between the sinking pontoons. Concrete filling was at once commenced in the haunches around the working chamber, and carried up over the roof. Lengths of air shaft were added as the filling progressed, while the exterior steel shell plating was carried up and strutted as required. At the time it was pitched on the river bed, the west caisson displaced about 4,500 tons. Work on the sinking of this caisson is shown in Fig. 7.

During the operation of lowering the caissons and pitching them upon the river bed, approximately 50 tons of concrete anchor blocks, weighing from four to seven tons each, were used on the upstream side of the caisson and 82 tons on the downstream side. Wire ropes were led from attachements on the caisson skin plating around blocks secured by mooring chains to the anchor blocks, and back to winches mounted on the sinking pontoons. In addition to these moorings, independent anchorages were made to points on the river banks. The sinking pontoons were moored independently of the caissons.

Concreting was carried out by two seven ton derrick cranes. Two 300 cubic foot Broom and Wade compressors were provided with a standby portable in case of emergency.

After pitching each caisson on the river bed, it was only possible to concrete up the walls of the machinery chambers to a level 16-ft. above the floor, prior to founding the caisson finally. This action was necessary, as portions of the steel work supporting the bascule trunnions and approach span bearings were embedded in the upper portion of the concrete walls. The steel work naturally could not be finally set until after the caisson was founded, and its position accurately determined. For this reason the last 17-ft. of the steel shell plating of the machinery chamber had to be temporarily supported by timber strutting. As soon as the caisson was founded in position the tower steel work was set and the concreting of the walls completed.

Erection of Approach Spans.—The steel trusses and portions of the deck of the shore ends of each approach span were erected upon the reinforced concrete decks of the approach viaducts behind the abutments. The shore ends of the spans were provided with rollers travelling upon specially prepared tracks on the viaducts. The river ends of the spans were cantilevered forward over the river, the spans being supported upon timber bends placed between the abutments and the river walls. When the spans were completed in this position, barges were floated under the nose end of each span, which was then raised clear of the support behind the river walls and carried between the rollers at the tail end and the barges. The barges were then towed out towards the river piers and the nose ends of the spans finally landed in the correct position upon the tower steel work, the tail ends of the spans travelling forward upon their rollers. The photographs reproduced in Figs. 5 and 6 show the launching of the East span.

Erection of Bascule Span.—The whole of the steel work and counterweight of this span was erected in the open position. Upon completion of the steel work each leaf was lowered in turn, and the deck erected in the horizontal position. The photograph reproduced in Fig. 8 shows erection work on the bascule spans in progress.

The contract for the construction of the bridge was placed with Dorman, Long and Co., Ltd., in the summer of 1929. The erection of the bridge was completed by June 1931, no less than five months ahead of contract time.

Single-Screw Motorships

The recent completion in Japan of two fast single-screw motor cargo liners serves to emphasize the trend now apparent towards a preference for single-screw propulsion for such ships, as against the more general arrangement of twin-screws favored a year or two ago. These two ships, the *Kirishima Maru* and *Katsuragi Maru*, attained on trials a speed of 18.029 and 17.75 knots respectively at about 7,000 b.h.p., the latter ship being propelled by the largest Burmeister and Wain 4-stroke cycle, single-acting, supercharged, airless injection engine so far constructed.

Even more remarkable is the preformance of the Japanese single-screw oil tanker *Fujisan Maru*, of 12,500 tons d.w., which is credited with a trial trip speed of 18¾ knots with her double-acting 2-cycle M.A.N. engine, developing 9,400 b.h.p. Single-screw propulsion has also been adopted in the three Westfal Larsen motorships, built and building in Holland, and designed for a speed of 16 knots at 6,700 b.h.p., as also in the two recently delivered A.P. Moller motor cargo liners, which have a designed service speed of 15 knots at 5,600 b.h.p.

Other recent examples of high-powered single-screw cargo liners are the *Europa* and *Amerika*, each propelled by the new Burmeister and Wain 2-cycle double-acting engine. While amongst these and other examples which might be cited, there are represented single-acting 2-stroke cycle and 4-stroke cycle engines, the tendency in high-powered single-screw ships appears to lean towards the adoption of the 2-cycle double-acting engine. In this type of engine, whether it be M.A.N., Burmeister and Wain, Sulzer or Hesselmann, it is now possible to develop up to about 1,500 b.h.p. per cylinder.

Since it appears to be unlikely that any single-screw cargo liner will be economically practicable with machinery of greater output than 10,000 b.h.p., engines of this type need not be built with more than seven cylinders, which represents an engine of moderate fore-and-aft length. The complete reliability of the diesel engine is now no longer questioned, and hence one of the earlier arguments in favor of twin-screws no longer applies. Theoretically, single-screw propulsion is more efficient than with twin-screws, and in practice the major benefits obtainable from special type stream line or reaction rudders are associated with single-screws. For these and other reasons—of which the choice of reliable high-powered, slow-running, double-acting 2-cycle diesel engines is but one—the single-screw drive is likely to be increasingly favored for future fast cargo liners.—*Journal of Commerce.*

Fig., 1.—View of the Kawasaki Docks with the three Loading Bridges for Coal and two Loading Bridges for Piece-goods

The First Great Coal Discharging Plants in Japan

THE consumption of coal in Japan is growing steadily as the rapidly progressing industrial development of the country makes headway. This in turn means ever more exacting demands to be satisfied by the appliances that bring the coal from the sources of supply to the consumers. Japan has a very long coast-line; that is the reason why most of the coal travels by water.

The chief ports of shipment, Wakamatsu, Otaru, Muroran, and Moji, are well equipped for loading the colliers, but the numerous landing places were sorely wanting in efficient discharging plant until a short while ago. This is due to the fact that a great many small undertakings take a share in the coal trade, the coal, hence, in numbers of instances, being delivered direct to the consumer who gets it in barges or small sailing vessels of 150 to 300 tons burthen. As a rule, therefore, the discharging appliances owned by the consumers are only meant for unloading such small craft; their capacity, accordingly, never runs to more than 40 to 50 tons per hour at the very utmost.

Fig. 2.—Coal Discharging Plant at Kawasaki, as seen from the water

Until two years ago, the Imperial Steel-Works were the only consumers who possessed discharging plant of their own capable of dealing efficiently with ocean-going vessels, and this plant they reserved entirely for their own purposes. In all other places the coal cargoes of ocean carriers had to be landed by means of manual labor only. During the last few years, however, Messrs. Mitsui Bussan Kaisha proceeded to have two big and quite up-to-date coal discharging plants built in the two chief landing ports. Both plants allow transportation to take place in every conceivable combination between ocean carriers, barges, lighters, storage dumps, and railway trucks.

The first plant, built in 1928, forms the equipment of the new coal docks at Kawasaki, on the main canal connecting Tokyo and Yokohama; the other one was put into commission recently at the port of Osaka.

Fig. 3.—Part of the Coal Discharging Plant in Fig. 2

Fig. 4.—Piece-goods Loading Bridges with Monorail Crabs

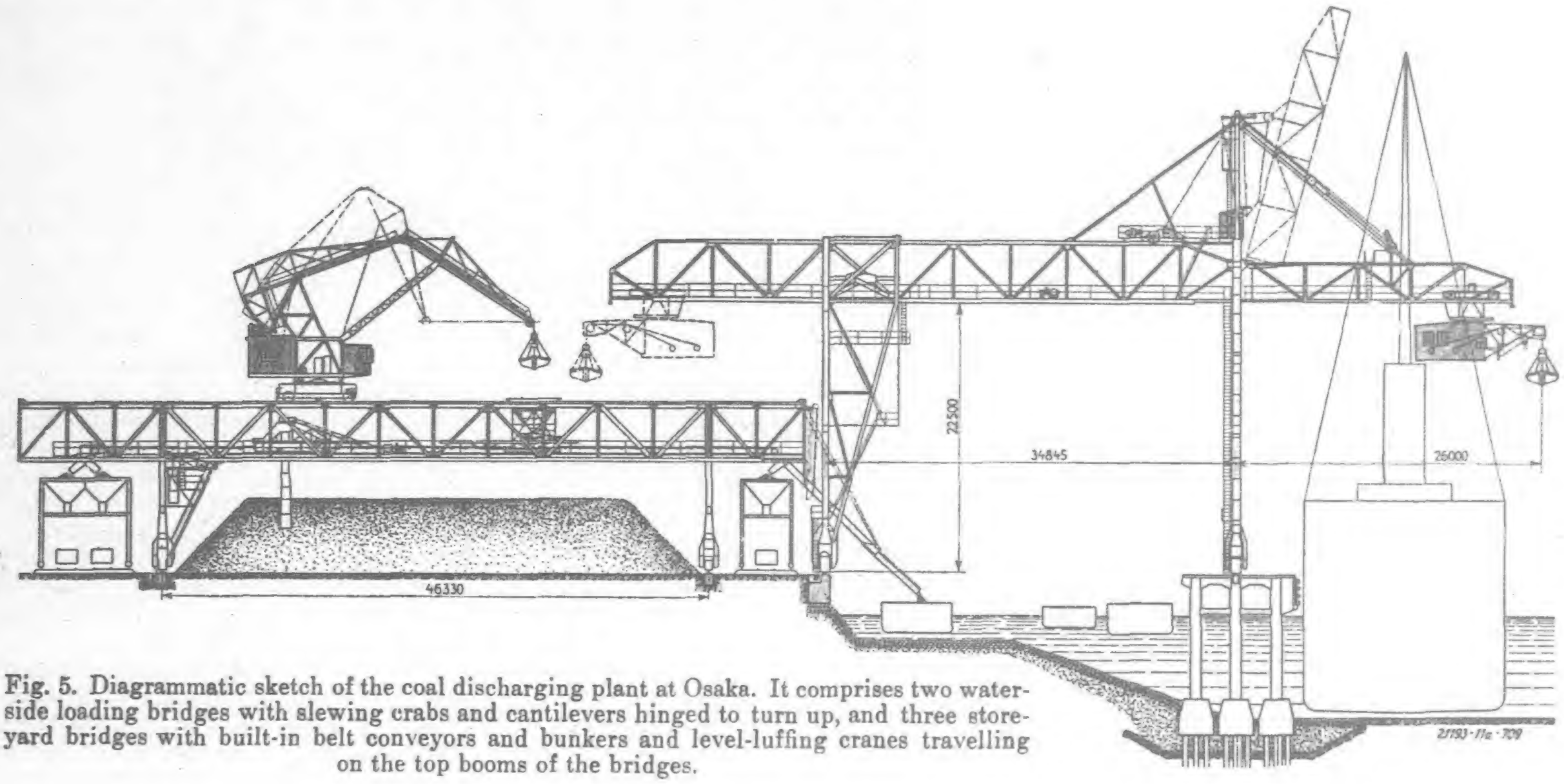


Fig. 5. Diagrammatic sketch of the coal discharging plant at Osaka. It comprises two water-side loading bridges with slewing crabs and cantilevers hinged to turn up, and three store-yard bridges with built-in belt conveyors and bunkers and level-luffing cranes travelling on the top booms of the bridges.

The new Kawasaki docks are arranged partly for transhipping coal and partly for handling piece-goods, Fig. 1. The three loading bridges of the coal wharf are able to travel along the whole of the wharf length, Figs. 2 and 3. Spanning 182-ft. (55.6 m), they bridge the store-yard and several railway lines, whilst their hinged cantilevers jut out over the water to a distance of 72-ft. (22 m.) from the edge of the quay. Several barges and an ocean carrier can therefore find accommodation alongside one another beneath each cantilever. The lower flanges of the main bridge girders and cantilevers are traversed by 10 ton slewing crabs with radii of 20-ft. (6 m.) and automatic grabs holding 8.5 cu. yds. (6.5 m^3). The crabs mainly serve to carry the coal between the sea-going vessels, barges, and store-yard, whereas the four ton slewing cranes that travel on the upper flanges of the bridge girders are reserved exclusively for the requirements of the yard and the railway trucks. The slewing cranes have radii of 40-ft. (12 m.) and automatic grabs of 2.6 cu. yds. (2 m^3) contents. The clearance between the water-side legs of the bridge is enough to let the crabs slew round completely even while passing through the portal.

Coal meant to go on by water is put into the barges by the slewing crabs which either take it from the store-yard or tranship it to them direct from the ocean carrier. But if it is to leave by rail or motor truck, a series of stationary and portable hoppers, built in Japan, and holding 60 to 70 tons, are used to load the trucks.

With manual labor, as was the custom previously, it took 30 to 40 minutes and eight to 10 men to load a 15 ton truck, whereas now two minutes are sufficient for the purpose. Manual work has been eliminated practically altogether. Only 10 men are wanted now in the whole yard for loading the trucks.

The comparative table below reveals to what an extent the new loading bridges improved the transhipping process, but it should be borne in mind, when considering the data, that the two cargoes compared are different as to weight, and that part of the cargo was still discharged in the old way at Kawasaki. A more detailed and exact comparison would prove the savings on hours worked and on lay-days to be even more in favor of the cranes.

Ship unloaded	*Coal cargo in tons*	*Unloading by Manual labor*	*Crane*	*Man days*	*Lay-hours*
Mandai Maru at Yokohama ..	6,000	6,000 tons	—	225	36
Kinkazan Maru at Kawasaki..	7,670	820 ,,	6,850 tons	80	28

The two loading bridges of Fig. 4 are used for transporting al sorts of piece-goods between sea-going vessels, lighters, the railway, and the dock warehouses. They bridge the latter and a three-floor warehouse, and their hinged cantilevers have a reach of 85-ft. (26 m.) beyond the edge of the quay. Each bridge has two three ton crabs with self-contained cabs for the drivers. Travelling at a speed of 395-ft. (120 m.) p. min., the two crabs work on independent tracks and are therefore able to serve the same hatch

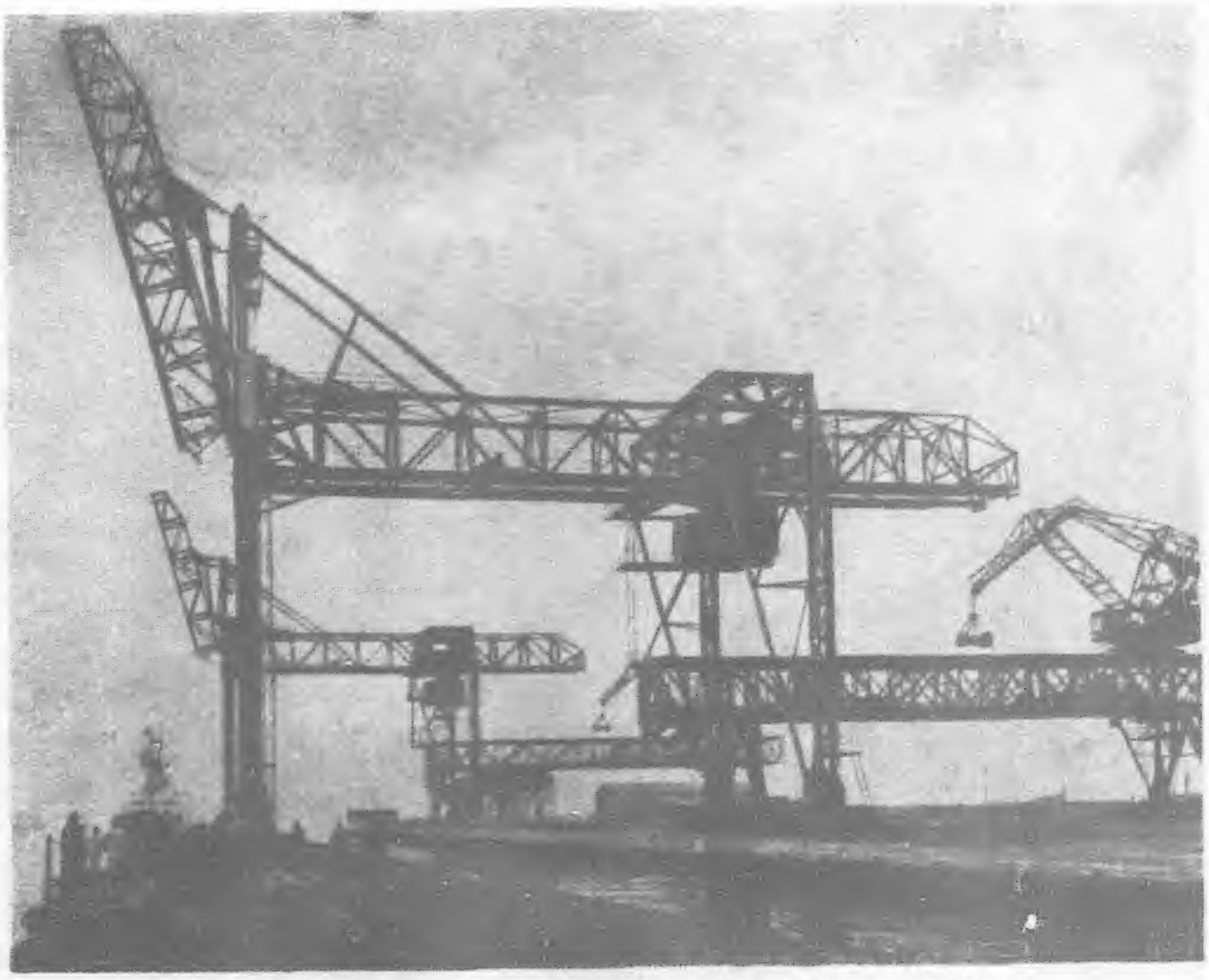


Fig. 6.—Part of the Coal Discharging Plant at Osaka

simultaneously, too. Each successive story of the warehouse is set back from the front of the one below, the roof of the latter thus forming a platform for the floor above where the goods can be deposited or taken up by the hook. Trap doors are also provided in the flat roof of the warehouse to serve as hatchways through which goods may be lowered into the building.

At Osaka the new coal discharging plant consists of two loading bridges with slewing crabs and cantilevers hinged to turn up, and three store-yard bridges with built-in belt conveyors and level-luffing slewing cranes travelling on the tops of the bridges, Figs. 5 and 6. Each store-yard bridge has a portable bunker holding 20 cu. yds. (15 m^3) which feeds the belts. In addition, a large number of portable hoppers were also included for loading railway trucks, the same as at Kawasaki. These hoppers were likewise built in Japan. A kind of concrete pier runs parallel with the shore. It carries one of the rails for the water-side bridges.

The sheltered basin between the pier and the shore affords accommodation for the smaller craft, like barges and lighters, whereas large sea-going ships make fast on the off-shore side of the pier, under the cantilevers of the bridges. So the water-side bridges are able to transhipp coal in every direction, as far as water-craft are concerned. Moreover, their land-end cantilevers enable them to take the coal from the ship's holds and deliver it ashore, either shooting it down on the dumps at the water-side end of the yard, or straight into railway trucks, or the loading hoppers, or the feeding bunkers of the store-yard bridges.

On the other hand, the water-side bridges are also able to take coal from the water-side dumps in the yard, transhipping it back into water-craft, or for the purpose of filling railway trucks *via* the loading hoppers or charging the feeding bunkers of the store-yard bridges. The level-luffing cranes on the store-yard bridges can do every kind of loading work required in the yard, besides being able to discharge barges or load them from the dumps, either direct or with the aid of interpolated belt conveyors and adjustable chutes.

The slewing crabs of the two water-side bridges have radii of 20-ft. (6 m.). Their grabs are automatic ones holding 4 to 4.5 cu. yds. (3 to 3.5 m^3), and they possess weighing machines suited for calibration. Each grab-load can therefore be weighed separately. The hoisting gears of the grabs are Demag box type winches giving hoisting speeds of roughly 170-ft. (51 m) p. min. The crab traversing speed is 490-ft. (150 m.) p. min. Slewing can be performed at the rate of two full revolutions p. min.

The store-yard bridges are equipped with belt conveyors to facilitate loading the hopper trucks, while at the same time saving long travelling journeys of the slewing cranes. The latter can take coal from barges, for instance, and put it into the bunkers of the bridge at its water-side end, whereupon the belts dump it into the yard further back or fill the hopper trucks standing beneath the inland cantilevers of the bridges. Measuring 31.5-in. (800 mm.) in width, the trough-shaped belts are designed to convey 150 tons per hour, and the direction in which they work is reversible. The return pulleys at the inland ends are provided with double chutes and adjustable flaps over which the coal is sent into the hopper trucks. At the water-side ends there are double chutes, too, for the purpose of conducting the coal into the barges and hopper trucks. An electrically operated throw off car serves to tip off the coal into the yard. The car has a contractible telescopic dumping pipe which prevents dust from forming and spreading in consequence of the dumping. Uniform feeding of coal from the bunkers on the bridge to the belt conveyor is obtained by means of a belt charging device actuated by electricity.

The slewing cranes on the store-yard bridges are double link level-luffing cranes, a type particularly well adapted for use in conjunction with grabs. When altering the radii of these cranes, their jib-head sheaves and the grabs always move horizontally. The path of the load thus remains clear and easy to judge for the operator of the crane. Besides, the load does not swing unduly in this arrangement. The maximum radius of the crane is 60-ft. (18.3 m.), reducing to 30-ft. (9.15 m.) as the smallest. The hoisting gear again consists of a Demag box type winch, and the grab has a capacity of 3.6 cu. yds.

The plant can also be used with piece-goods. With this end in view, all the slewing cranes and slewing crabs were fitted with tackles that allow the grabs to be removed and replaced by hooks without much trouble.

A Valuable Book of Reference

A new and valuable work of reference of special interest to all those engaged in export commerce has lately been produced in Germany by Dr.-Ing. E. Kurt Lubowsky. This is "Hilfsbuch fur den technischen Aufsenhandel" or the "Technical Export Handbook." The information that it presents is published in four languages in parallel columns.

The book is the product of 450 different questionaires on plant and products comprised in the export trade of the general and the electrical industries. An appendix contains important national and international data, conversion tables and particulars relating to climate and altitude. As set forth in the preface, "the fundamental idea leading to the publication of the 'Technical Export Handbook' was the knowledge that industrial representatives abroad, as well as exporters and importers, must often be perplexed by the multifarious aspects of the different technical problems encountered."

The securing of business demands preliminary technical negotiations, but, in many instances, the agent in charge of the transaction does not possess the requisite specialized technical experience. Postal and telegraphic correspondence involves loss of time without guaranteeing sufficient elucidation. Much good business has been irretrievably lost at the very outset due to the unavoidable uncertainty shown by the foreign representatives of varied business interests towards the preliminary questions and terminlogy linked with schemes which are submitted to him or which he hopes to secure by fortuitous connections.

"The object of the Handbook is to redress this deficiency. The text being in several languages, facilitates correspondence and transactions for the selling agent, irrespective of country. Even though many firms distribute their own query sheets, these are generally known only to the permanent representative, and are seldom available in a clearly indexed arrangement in export houses as necessity demands. For the purpose of preliminary negotiations, the informatory literature of the industrial firm at home is seldom adapted to the mentality of the exporter and outside representative, who are mainly interested in selling points. Notwithstanding, the Handbook is also intended for perusal by the estimating engineer.

"In this first edition a wide circle of firms in various ramifications of industry has been consulted, and data utilized which have been collected in the course of many years. It remains with the industry to show its interest and co-operation in fostering the work commenced."

In view of the different categories of industrial and commercial circles interested in technical export trade, considering the broad basis of the subject-matter and the fact of its being published in several languages, it will be found helpful in the perusal of the book to note the following.

The book is primarily intended for estimating purposes and not for the placing of orders. The original questionnaires, which various firms placed at the author's disposal, have been reconstructed in conformity with this viewpoint.

Thus they have been abbreviated and freed from all details which arise in connection with an order to accord with prevailing conditions. Data having no important bearing upon prices or essentials of the estimate were deemed unnecessary and accordingly omitted. In particular, this refers to questions accruing from the customary practice of the manufacturer and the special requirement of the client in respect of construction on details.

The German, English, French and Spanish index to the book permits of speedy reference to the key-words in each of these languages. Thus, in the index, the title of each subject dealt with may be found in different combinations under various initial letters. In view of their frequent occurrence, terms such as plant, equipment, etc., have not been indexed.

It was found impracticable to classify the questionnaires under definite technical groups as many key-words would have been unavoidably repeated. In order to treat any particular engineering subject, it is essential to refer to the alphabetical index of the languages in question.

Two of the 750 ton Blast Furnaces at Kuznetsk

Production Starts at Kuznetsk*

Blast Furnaces and Open Hearths of Siberian Steel Plant are Now in Operation

By E. P. EVERHARD, Senior Engineer, Freyn Engineering Company, Kuznetsk, Siberia

THE blowing in of the first two blast furnaces at Kuznetsk Metallurgical Works, followed by the tapping of the first heat at the open hearth plant, mark the culmination of a dream that patriotic Siberians have had for centuries. It was in the early years .of the 13th century that the Nomadic conqueror, Genghis Khan, established primitive forges in Siberia for the recovery of iron, but in the seven succeeding centuries this industry grew to comprise only two producing centers, with a total production of approximately 10,000 tons per year.

Because of its central location and immense coal deposits which are almost surrounded by various deposits of ore, limestone and dolomite, the Kuznetsk basin has been the focal point of all subsequent projects to increase this production. However, up to 1927 these efforts gave little result, and it remained for the dominant and purposeful Soviet Government to crystallize these dreams and bring these efforts to actual construction of a plant.

To make provision for the future growth of the industry within the district, the Kuznetsk Metallurgical Combine was formed, and because of the undeveloped and isolated nature of the country the initial unit was so designed as to be the hub of a vast development leading to ultimate production of seven million tons annually within its jurisdiction.

Thirty per cent of the ore supply required for the first two blast furnaces will be obtained from mines at Telbes and Temir Tau, located 62 miles south-west of Kuznetsk. Limestone will be obtained from Gurievsky, 62 miles north-west of Kuznetsk, and dolomite from a new mine, 310 miles north-east of Kuznetsk. The balance of the ore required for the first two furnaces, amounting to upwards of 1,500,000 tons annually, will come from the new mines at Magnitogorsk, 1,250 miles west of Kuznetsk. Cars bringing this ore into Kuznetsk will return with coal for delivery to the Magnitogorsk steel works.

The general plan of the initial producing unit can be seen in the accompanying drawing. It is located near the old town of Kuznetsk, as shown in the map.

Initial project and general plans were prepared in 1928 in Chicago by the Freyn Engineering Company, and preparation of the site was begun by Soviet organizations in the summer of 1929. In 1930 the annual capacity of the project was increased to 1¼ million tons and Freyn Engineering Company was called in to supervise the enlargement of the project, the purchase of equipment and to superintend the actual construction work. This activity, begun in July, 1930, entailed direct participation in Moscow, Leningrad, Germany, and on the site at Kuznetsk. Approximately 25 engineers were involved for one year in the activity in these outside districts in addition to the staff at Kuznetsk, and at the present time all work is centered at Kuznetsk under the direction of Freyn engineers and superintendents located here.

The site selected is a strip of relatively flat ground, 0.6 mi. wide and 2.5 mi. long at the base of foot hills, and 2 mi. from the river Tom. It is paralleled on both sides by a newly constructed city, sufficient for a population of 50,000 people.

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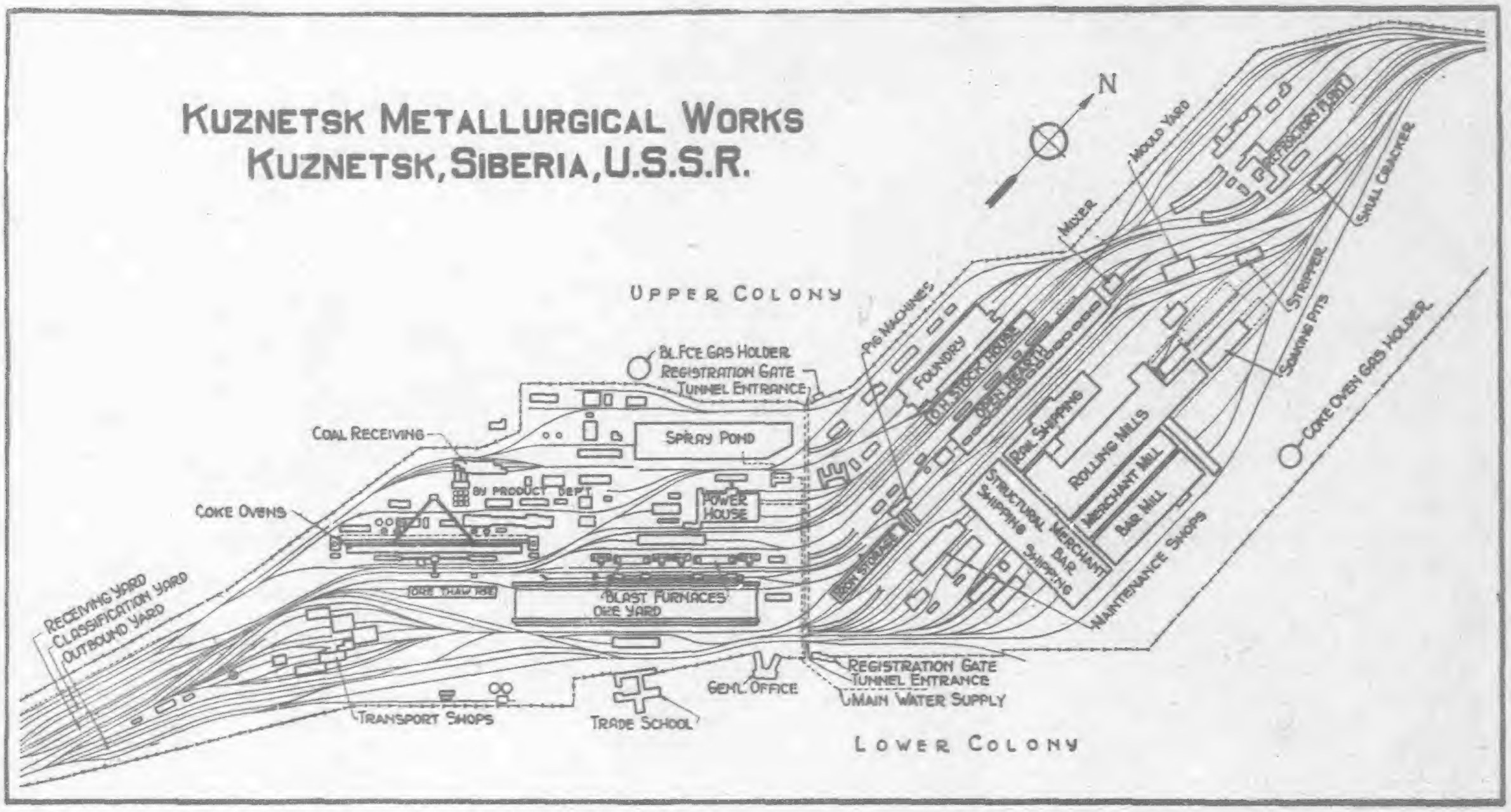
*Freyn Design.



The by-product coke oven department, located at the south end of the plant, consists of four batteries of 55 ovens each. Ovens are arranged for under-firing by either coke oven or blast furnace gas, though the latter will normally be used in order to release coke oven gas for use at the open hearth and mill heating furnaces. Ovens are expected to produce 1,100,000 tons of metallurgical coke yearly, operating on a coking time of 17 hr.

Four modern, fully mechanized blast furnace stacks will comprise the blast furnace department. The four furnaces are arranged in a straight line with common cast houses serving two furnaces each. For the original projected tonnage it was intended to install three furnaces of 750 tons daily capacity, and design and fabrication were partially completed on these at the time of increasing the capacity of the ultimate plant. While a larger size unit was indicated by the revised tonnage, it was found that two of these furnaces could, nevertheless, be utilized.

Furnaces 1 and 2 therefore follow the original lines and are nominally rated at 750 tons, with provision in brick lining, stoves, skips and blowers for enlargement to 850 tons daily. Furnaces 3 and 4 are of somewhat different lines, being influenced in hearth and bosh dimensions by utilization of certain steel parts fabricated for Magnitogorsk works. These are rated at 1,000 tons daily capacity. Comparative dimensions are given in the following tabulation :

	Furnaces 1 and 2	*Furnaces 3 and 4*
Hearth dia.	20.3-ft.	25.0-ft.
Bosh dia.	23.6-ft.	27.5-ft.
Stockline dia.	18.0-ft.	20.0-ft.
Large bell dia.	13.4-ft.	15.1-ft.
Height of hearth	10.2-ft.	10.0-ft.
Height of bosh	10.5-ft.	10.0-ft.
Height of inwall	48.2-ft.	55.8-ft.
Height of stockline	6.8-ft.	6.6-ft.
Overall height	92.7-ft.	99.1-ft.
Capacity skip tub	176.5 cu. ft.	211.6 cu. ft.
No. tuyeres	12	16
No. of columns	12	8
Angle of bosh	81.11 deg.	82.92 deg.
Angle of inwall	86.68 deg.	86.16 deg.
Volume in cu. ft.	28,946	40,665

Brick enclosed hoist houses are located under cantilever type skip bridges and include latest type hoists for both skips and bells. Tops are equipped with a revolving distributor and Freyn-Design Stockline Recorders.

The entire area surrounding both furnace and cast house is enclosed in brick walls. This house is arranged to span both iron and slag tracks and served by a 15 ton crane.

To insure utmost freedom in carrying any desired blast temperature in the severe Siberian winters, four stoves, 25-ft. in diameter and 115-ft. in height are used for each furance. These stoves are equipped with the following specialties: Freyn-Design pressure burners and chimney valves and hot blast valves. Because of the severe climate, the entire stove floor is enclosed in a self-ventilated building with steel roof and brick side walls.

The ore bins are of Freyn-Design, consisting of a double line of rigid pockets, entirely of steel construction. It is equipped with the Orr patented roller feeders, operated by the scale car. Pockets are of large dimension, providing 36 hr. storage for ore and miscellaneous material, and 8 hr. storage for coke.

The blowing station, located centrally between the four furnaces on the slag side, houses five Brown-Boveri turbo-blowers, each having normal capacity of 90,000 c.f.m. per min, at a pressure of 22 lb. per sq. in.

The entire production of blast furnace gas will be fine-cleaned, the system comprising primary and tangential secondary dust catchers for dry cleaning, and thence through wet scrubbers, disintegrator gas washer, tower type moisture eliminators to the clean gas header. This clean gas main will supply gas to blast furnace stoves, boiler house and coke ovens as well as to open hearths and mills after the pressure is boosted to approximately 14-in. of water.

No. 1 Blast Furnace was blown in on April 1, 1932, and the first cast was obtained April 3. During the first eleven days the total production was 2,478 tons. On April 11 the production for 24 hr. was 426 tons, the last cast having 2.33 silicon. On this date the wind was up to 43,000 c.f.m. By April 17 the total production was up to 3,678 tons and the daily production was over 600 tons. Production for May and June averaged over 20,000 tons per mo.

The No. 2 Blast Furnace was blown in in July. Erection of No. 3 Blast Furnace is already under way.

A modern, high-efficiency power station is erected approximately in the center of the plant. This consists of eight steam boiler units, fired by powdered coal and blast furnace gas, with oil for emergency. Boilers have 27,000 sq. ft. heating surface and liberal water walls in the combustion chamber.

The generation side of station will include two 6,000 kw., 3,000-volt house turbines and four 24,000 kw., 6,000-volt main generating units. Surface type condensers are used. Turbine drives are from Rateau for house units and Wumag for the 24,000

Power House at left, Blast Furnace in center, and Coke Oven Plant at south end of Works. Soyuzphoto, Moscow

kw. units. All generators are of Russian manufacture. Condenser equipment is German. Approximately 40 per cent of the generation of this plant will be used in the local steel works; the balance will be sent overland at 132,000-volts to coal mines and other consuming industries in this district.

The main open hearth building houses fifteen 150 ton stationary furnaces, constructed with particular reference to efficiency of fuel and materials to be used. Hearth has net dimensions inside banks of 44.9-ft. long and 15.7-ft. wide at the level of door sill, and 2.5-ft. deep at tapping hole. It is entirely supported by heavy steel grillage on concrete piers and equipped with extra heavy rolled steel buck stays and water-cooled doors. Both air and mixed gas will be regenerated and to provide ample preheating, extra deep checkers are used.

Four 7½ ton Morgan floor chargers and two 125 ton overhead ladle cranes will serve the charging floor. The pouring pit is served by four 220 ton ladle cranes. Four pouring platforms, of sufficient size to teem tow heats each, are provided with intermediate track crossovers, permitting the heats to be drawn from either end.

It is expected that this open hearth department will produce approximately 1,250,000 tons of ingots annually. The first heat was tapped from the open hearth on September 19, 1932.

The rolling mill department is deserving of special attention, due to its compactness of layout, flexibility of operation, and wide range of product. It is placed parallel with and east of the open hearth department.

Kuznetsk Rail and Structural Mill

The requirement of this department calls for the rolling of 1,250,000 tons of ingots to the following variety of product:

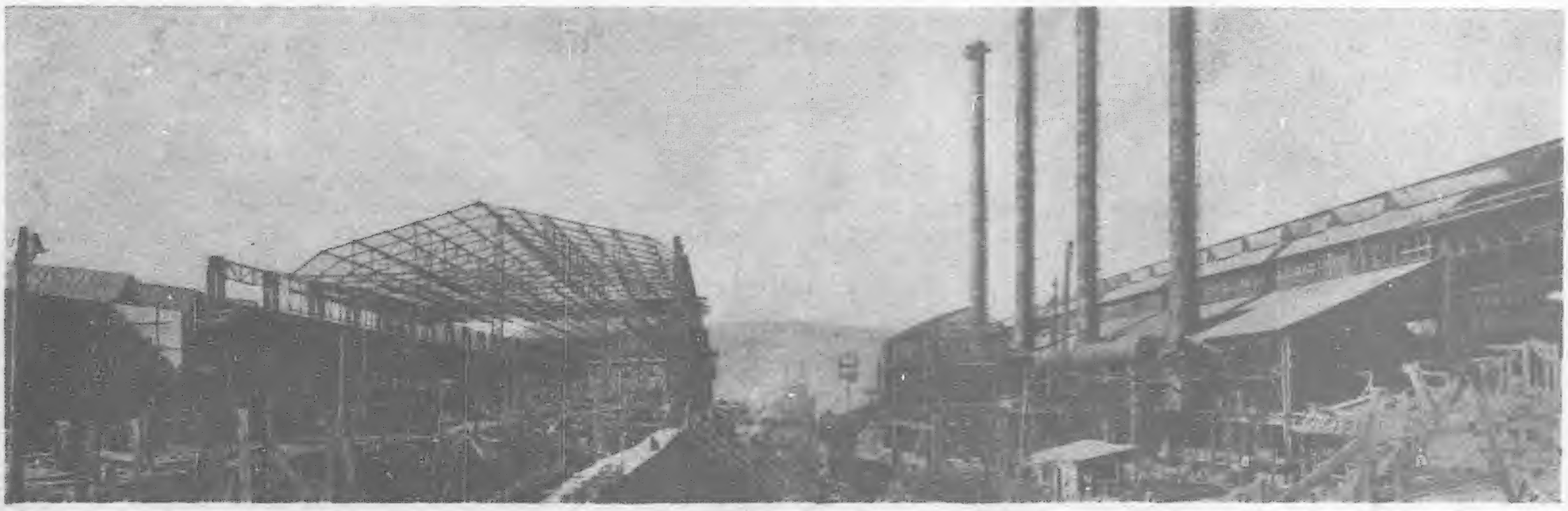
1. Rails from mine section to standard 100 lb. rail.
2. Splice bar and tie plate sections for the above rails.
3. Full line of structural sections from 1-in. angles to 24-in. beams, weighing 88.7 lb. per ft.
4. Boiler and tank plates, 11 gauge and over, from 19-in. to 71-in. wide.
5. Agricultural shapes.
6. Wire rod.
7. Merchant bar, full range of sections from equivalent of ¼-in. to 7¾-in. rounds.

Under ordinary conditions, such a large tonnage in such a wide range of product on a single set of mills would entail considerable idle investment, however, within the Soviet Union, state controlled industry permits the scheduling of large orders of given size rolled product, and it was necessary to take full advantage of this factor in the assembly of units.

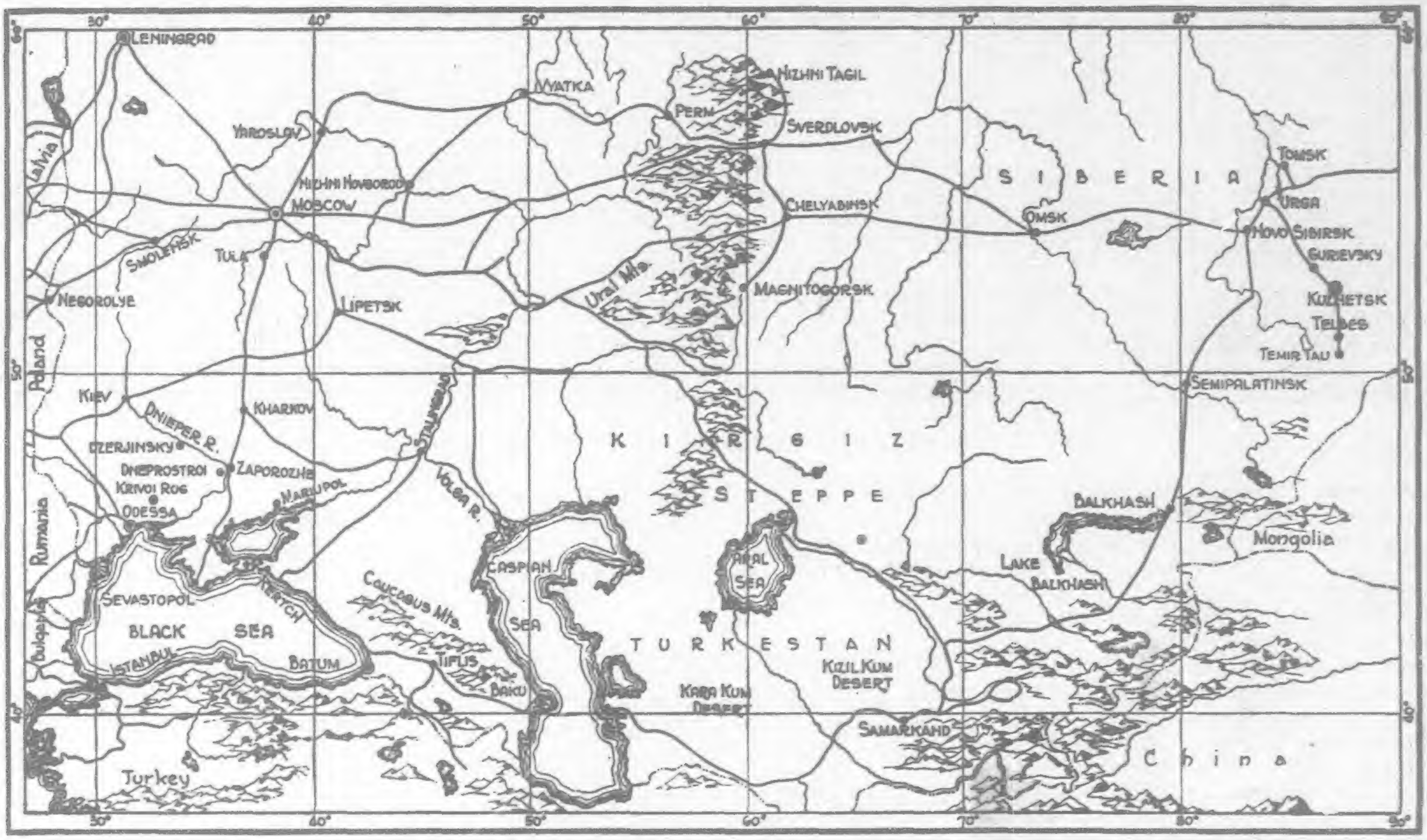
The rolling mills which are now being erected comprise the following: blooming mill, rail and structural mill, billet mill and merchant mills. It is expected that some of these mills will be placed in operation this fall.

Both a workers trade school and a technical university for higher education is already established for the training of skilled personnel. Over 40,000 workers are employed in construction, and it is estimated that 12,000 regular employes will participate in operation.

(Continued on page 42)



Open Hearth at right with Stockhouse at left



Journeys to the Iron Mines of Russia*

Interesting Facts Regarding the Extent and Quality of Ore Deposits in the Soviet Union

By L. D. ANDERSON, Freyn Engineering Company, Leningrad, U.S.S.R.

THE new industrial program of Russia lends particular interest to her iron mines, the foundation of modern mechanization. It was with keen curiosity, therefore, that various journeys were made to representative mining districts.

Traveling south from Moscow about 120 miles, one comes to the ancient mining town of Tula, founded toward the end of the 11th Century. Overrun by Tartars and Lithuanian raiders, the town became an important strategical point, whose importance is evidenced by its ancient Kremlin, or fortress, standing to this day after four centuries of stirring history. The necessity for obtaining weapons against the Crimean Tartars caused the development of the iron industry, established by Winnius and Alsema of Holland, and Marselius of Hamburg, who brought in 600 workmen from abroad. Coincidentally came the development of iron industries of many kinds. Here are manufactured the famous samovars of Russia. Blast furnaces, foundries and rolling mills of primitive type tempt one to linger long in their inspection.

The iron mines are chiefly open pits worked at points where the ore deposits outcropped in ravines and gullies. Later explorations have shown that iron ores underlie an area of 700 sq. km. The deposits are flat lying lenses of limonite, varying in thickness up to 7 m., overlaid by loam, clay, sand and sandstone, and resting on a substratum of clay or sand. The bottom of the ore is quite irregular in synclines and anticlines which are occasionally up to 30 deg. slope. The practical mining man will recognize the difficulties of ore extraction underground in such a district where the average thickness worked is about two meters and the "backs" are weak and liable to run. The ore itself is curious in appearance, consisting of geodes and chunks in a matrix of ochre, often dense and hard, yet again soft enough to be picked down by hand. The iron content varies from 45 per cent to 55 per cent with an average of 48-49 per cent with a silica content of 10 per cent and moisture of 13 per cent. The Keerevsky mine, the only underground one at present operating, has five shafts, one with a small steam hoist and the others with horse whims. About 150 miles further south one comes to the smaller field of Lipetsk with similar deposits. The Seersky mine, the only one in the district at present operating, has several shafts put down in a flat lying terrain to the ore which is about 160-ft. from the surface. Here one is reminded of the sheet zinc deposits of Missouri and Oklahoma.

The ore rests on a limestone base, irregularly folded, with an overburden of loam, sand and clay. The ore reserves here are estimated at 4,000,000 tons with an estimated recovery of 85 per cent to 90 per cent in mining. Washing of the lower grades is projected.

Learning that the enterprising blacksmith, Demidov, who established himself at Tula in 1701, was commissioned by Peter the Great to develop the Ural iron mines in 1707, one turns with anticipation toward that famous mountain range whose mineral wealth founded the fortunes not only of that family but of many others. The train climbs the long gradual slope so slowly that one does not realize when he is in the mountains until he observes the sign indicating where Europe ends and Asia begins and at last arrives in the bustling city of Sverdlovsk. Fighting a way through the dense crowds in the station in which are mingled strange peoples, Bashkirs, Yakuts, Turcomens, Kirghiz, and others, one finds himself in a city of several hundred thousand inhabitants, the administrative headquarters for "Vostokostal" (East Steel), managing the vast mines and metallurgical works of the Ural-Siberian region.

An overnight journey of about 90 miles brings one to Nizhni Tagil, a representative mining town, where are located the open pit mines of Visokaia Mountain and Lebyashka with some smaller

**Freyn Design*

underground mines. The vast yawning pit of Visokaia is a silent testimonial to the great amount of work which has been carried on here. Yet systematic exploration has revealed that more ore remains yet to be mined than has been taken out in over two centuries past. There will be this difference. Whereas in the past ore was slowly broken by hand, loaded onto carts or sleds and hauled out by horses up winding roads, now it will be broken down by giant blasts of dynamite and loaded onto standard gauge railroad cars by electric shovels. Then will disappear from the pits the sturdy Siberian ponies and their drivers, rosy-cheeked lasses with heads enwrapped in colorful shawls.

The new wholesale method of mining will necessitate beneficiation of the ore. Although hand selection maintained the grade of the mined ore in the past, the shovels now will take everything, high and low grade. In general, the ores vary from magnetite in one end of the pit, through semi-martite in the center to martite in the other. Specks of pyrite and chalcopyrite distributed irregularly in the ore necessitate attention to means of reducing the sulphur content. Magnetic concentration is to be adopted with the possible use of fine grinding and flotation for the recovery of copper in the chalcopyrite. A further resource lies in the "float" or "pebble" ores, bits of high grade iron ore embedded in the clays of the glacial drift in the adjacent flat valley, to be recovered by washing.

At nearby Blagodat are mines of similar character. Smaller mines extending to Nadezhdinsk in the far north are the basis of numerous charcoal iron blast furnaces, producing particularly clean pig-iron. Here was produced, from such material, the famous "Russia iron," hammered out in packs by trip hammers driven by water wheels. To the south-west, particularly in the Bakal district, lie iron ores very low in sulphur and phosphorus.

Returning to Sverdlovsk and boarding an airplane, flying over Chelyabinsk to the south for a hundred miles or more, there is suddenly revealed one of the world's sights, the great iron ore deposits of Magnitnaya, or Magnet Mountain, and alongside it the building of a vast steel works, known as Magnitostroy, or the Magnitogorsk Steel Works. Here may be seen 52,000 workers engaged in development and construction work.

Loading Iron Ores at Kertch

On the north and south slopes of Magnet Mountain, with an altitude of 400 m. at the base and 610 m. at the top, lie two separate deposits of iron ore. The larger north body, the one now being developed, is described as in the form of layers, the layers of ore being interbedded with layers of rock, more or less evenly along the entire formation. Sometimes the ore veins are cut by veins composed mainly of porphyry, in places very large and without ore. The ores are of three kinds:

(a) Scattered Ores. Under the thin top layer of overburden the upper portion is weathered, resulting in lumps of ore of various sizes embedded in clay, varying in depth from 9 to 15 m.

(b) Intermediate Oxidized Ore. The original deposit of ore here, varying from 10 to 65 m. in depth has been affected by oxidation and leaching of percolating waters.

(c) Primary Ore. Beneath is the primary ore, a magnetite carrying unevenly distributed pyrite, giving a general average of 2.28 per cent sulphur to the whole. Varying in thickness from 10 to 100 m. it averages about 50 m.

The whole deposit, about 2,300 m. long and 1,000 m. wide has been stated to carry 375,000,000 tons of ore, with exploration still incomplete. Flat lying, conforming to the general slope of the mountain, the deposit is ideal for shovel mining in open pits. It does, however, offer problems in concentration on account of the erratically distributed clay. High grade primary magnetite comes right to the surface at some points while at others the clay is 15-in. deep.

Time does not permit us to travel to the east to the magnetic ore deposits of Telbes, tributary to the large Kuznetsk steel plant, which is being built by the Feryn Engineering Company, but hurries us to the far south in the Crimea.

At the eastern end of the peninsula lies Kertch, an ancient Greek colony, a rich field for archeological exploration. Here lie vast deposits of a strange ore, a sort of yellow to brown limonitic oolite. Flat lying, varying in thickness from 6 to 10 m., generally soft, these ores are cheaply mined by continuous bucket excavators of German design, a low cost method offsetting somewhat their low grade. The general average is about 38 per cent Fe., 18 per cent SiO_2, and 8 to 10 per cent moisture as mined. On account of its hygroscopic nature, the water in the ore may increase up to 20 per cent to 30 per cent if it stands long after excavating. Much of the ore carries arsenic, from 0.05 per cent up to 0.55 per cent. Phosphorus is high, up to 1 per cent. Some vanadium, up to 0.05 per cent, is present. Manganese is also present, from 0.8 per cent up to 4.0 per cent. While this looks like a low grade ore, the vast reserves estimated as high as two and one-half billion tons, give these ores great economic importance. Even the casual visitor would find them interesting for the little "oolites" (egg shapes) found in them, varying from pin-head to marble size. Fossil clams are quite common. Situated near the sea shore, it is planned to use cheap water transportation for carrying this ore across the Sea of Azov to the Mariupol Works, in addition to rail transport to the Kertch steel works.

Again requisitioning an airplane, one flies south-west from Kharkov over the great Dnieper River hydro-electric power plant to Krivoi Rog, a little country town in the midst of an iron field carrying Russia's richest iron ores. The Proletarsky mine now outputting nearly 2,000,000 tons a year expects to shortly double its production. The Karl Liebknecht mine at the other end of the field, modernly equipped, is shipping high grade ores to several European countries. The original open pit mining of this district is fast giving way to deep underground mining with modern skip hoists. Here the ores are true hematites, similar in appearance to the "blue specular hematites" of the Lake Superior region except that they are much softer. The grades are very high, up to 66 per cent, and more, in iron. Ore under 58 per cent iron here is spoken of as "low grade." These are vast reserves of so-called quartzitic ores, having a banded structure and suited for concentration of magnetic separation. These are also great dumps of banded hematites which are amenable to jigging. Altogether this district has been estimated by various engineers to carry over a billion tons of good ore. The deposits of this district are the mainstay of the several steel works in the Dnieper River and Don Bas regions.

Active exploration is frequently disclosing new deposits. A recent discovery in the South Urals is an iron ore carrying chrome and nickel. When it is considered that the iron mining districts so briefly mentioned above, do not include several smaller districts, it will be clear that the country's resources are, indeed, great.

The hand winches, horse whims and pony sleds found still in use in the Ural mines, contrasted with the steel head frames and American air compressors in use at Krivoi Rog, tell a story of transformation as vivid as the sight of the classical old Demidov palace, overlooking the ancient Tagil iron works. It would require a bold imagination indeed to set forth adequately what shall be the future status of iron mining in Russia.

Production Starts at Kuznetsk

(Continued from page 40)

The assembly and construction of this mammoth plant in the center of this barren country, with all the attendant difficulties of executing new designs with unskilled labor and new transportation, constitutes one of the greatest pioneering enterprises in the history of steel.

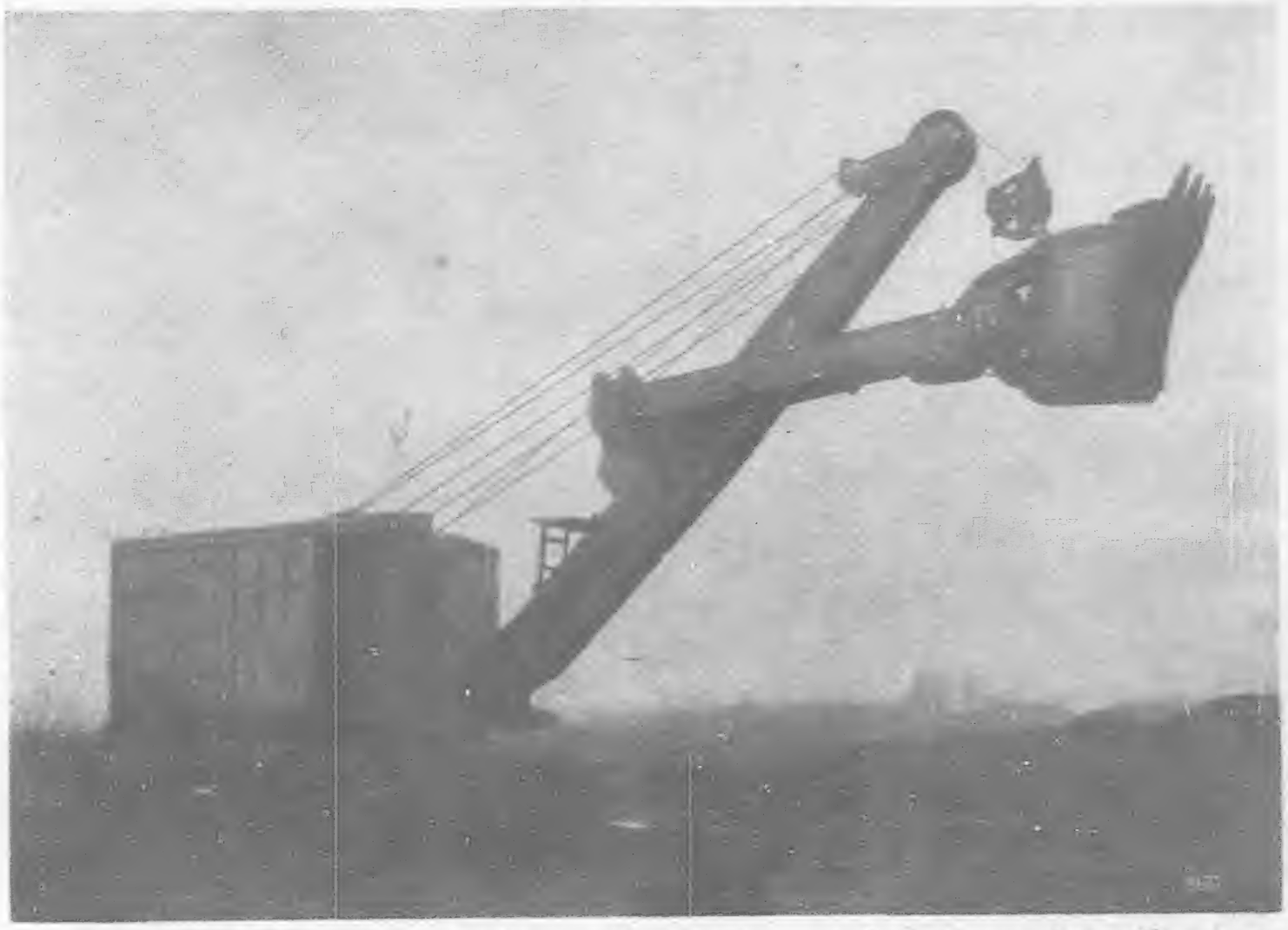
Five Excavators Purchased for New Civil Aerodrome at Singapore

FIVE electrically operated excavators equipped as shovels, with buckets of one cubic yard capacity, ordered by the Crown Agents, were recently shipped by Ruston-Bucyrus, Ltd., to Singapore, where they will be used in the construction of the new Civil Aerodrome.

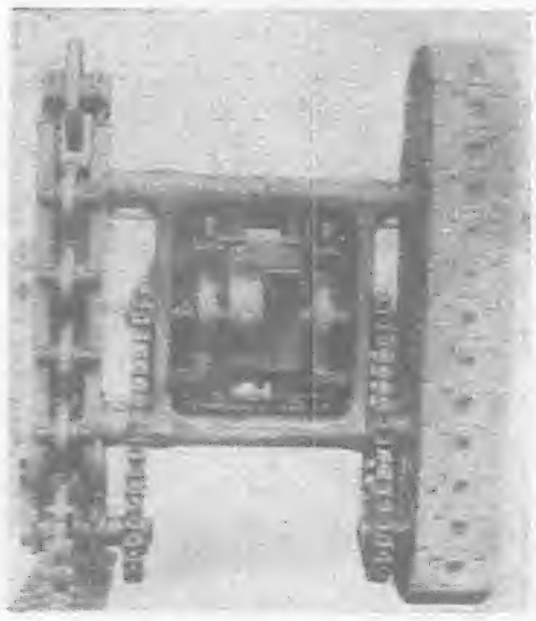
Singapore is, of course, one of the leading shipping ports of the East, where most of the routes to the Far East converge, as do also some of those to Australia. Singapore, therefore, lies at a strategic point in the lines of communication of the world, and with the great developments taking place in air communication at the present time, it has become important to establish at Singapore, a first class air port with facilities for both land and water machines

Unfortunately the locality chosen as the site for the new air port is singularly devoid of suitable flat pieces of ground for landing places. The country is much broken up and consists of low ridges interspersed with tidal creeks. It is therefore necessary that a great deal of levelling and dredging be done before suitable landing grounds and bases become available for use of land and sea planes.

The land is exceptionally hard, and would require loosening by picks before it could be done by hand labor. Under these circumstances, bearing in mind the factor of economy in working costs and speed of completion, mechanical excavators are obviously required. The machines supplied by Ruston-Bucyrus, Ltd., are known as the 32-B Models, and they are fitted with Ruston-Bucyrus rope thrust to control the thickness of cut and the working radius. A useful feature of this control gear is that it enables the bucket to be vigorously shaken to clear itself of the sticky clay which will be encounted on the site.



Type of Excavator supplied by Messrs. Ruston-Bucyrus, Ltd. for work at Singapore



Simplicity and strength characterise the Mounting of the 32-B Type Ruston-Bucyrus Excavators with no complication in the Propelling Drive. Machine has but two Gears Below Deck Enclosed and running in Oil

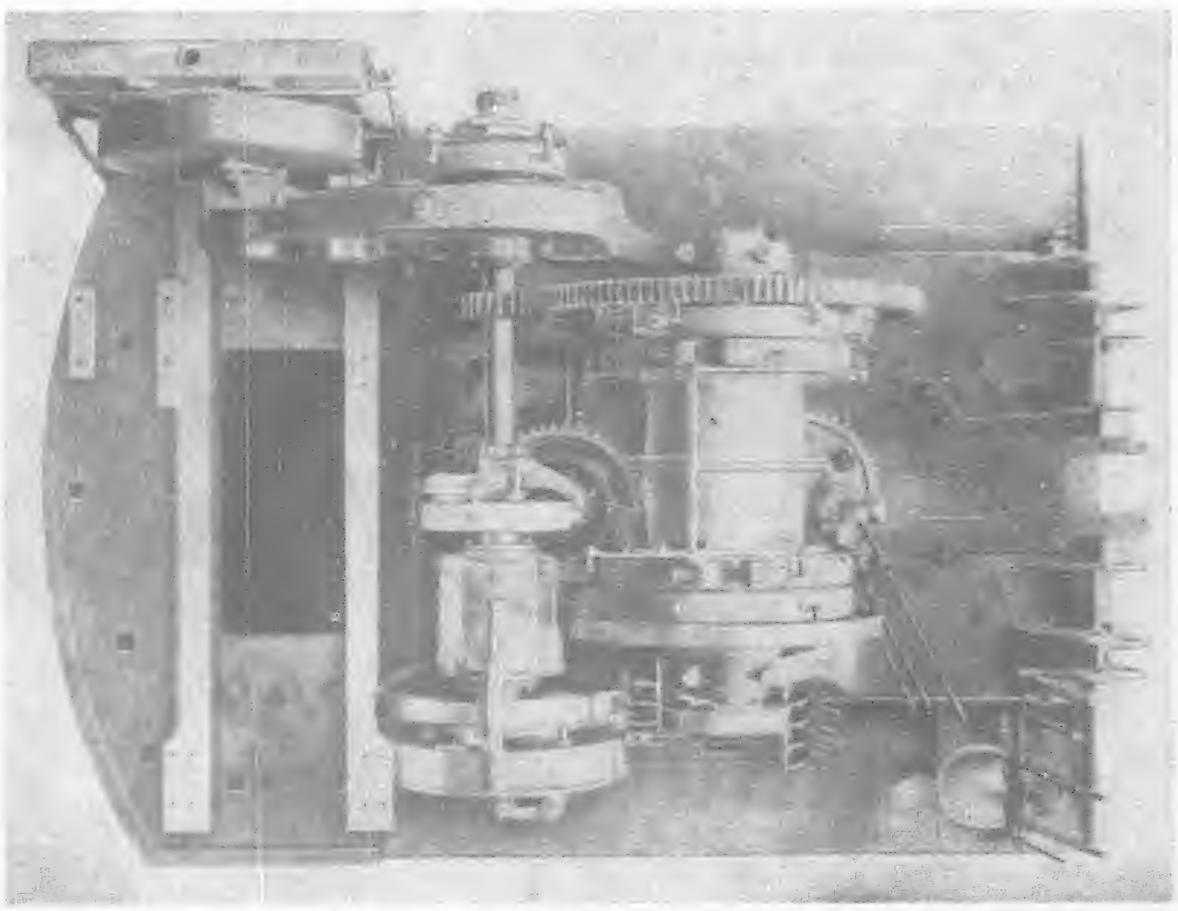
The machines also embody the following features :—

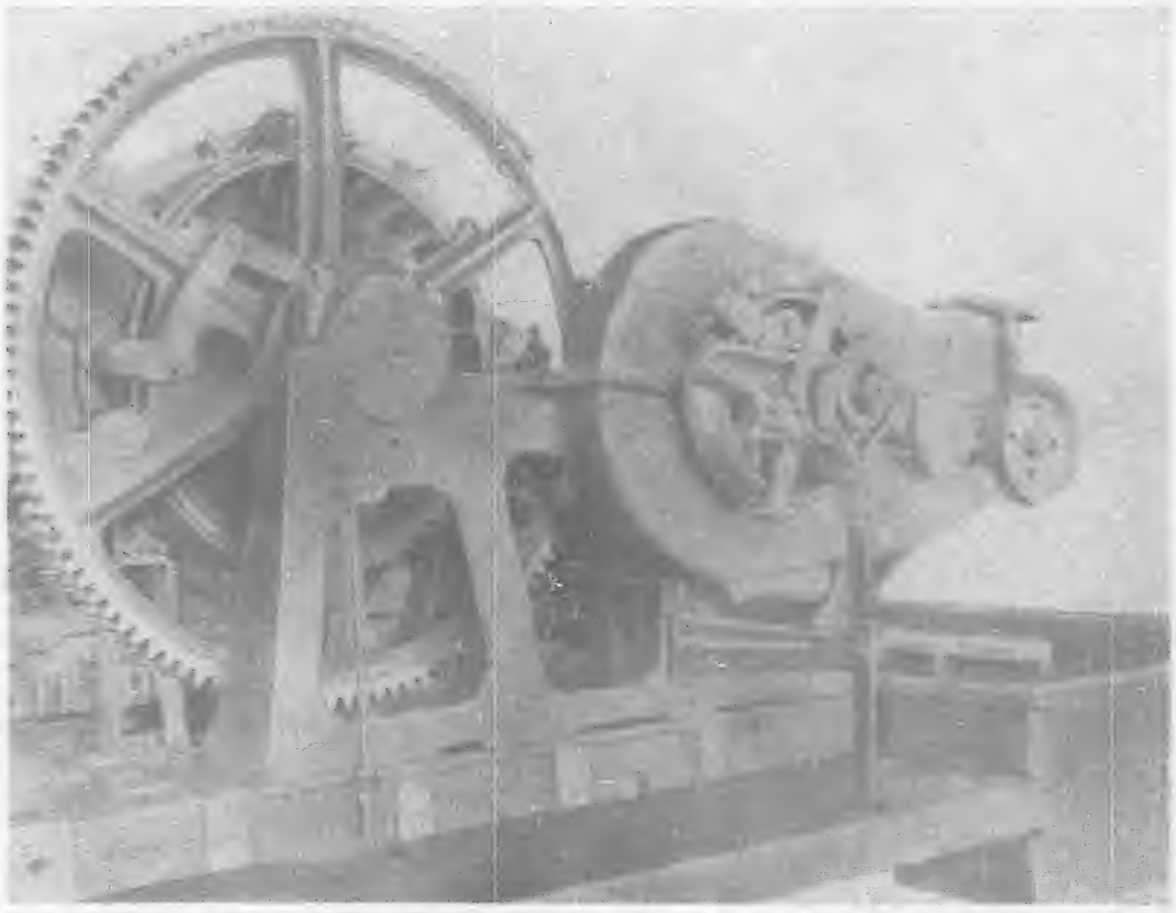
Machine-cut gears to all the leading motors, fully enclosed and running in oil.

All the leading shafts are mounted in ball bearings.

The machines are mounted on the latest design of caterpillars with cast steel undercarriage.

The caterpillar drive and steering under the easy and direct control of the operator.





Complete accessibility is a Feature of the 32-B Type Excavator with plenty of space around the Machinery. At Right note Outside Band Main Clutch at Forward End of Enclosed Transmission

Modern Fans and Dust Collectors

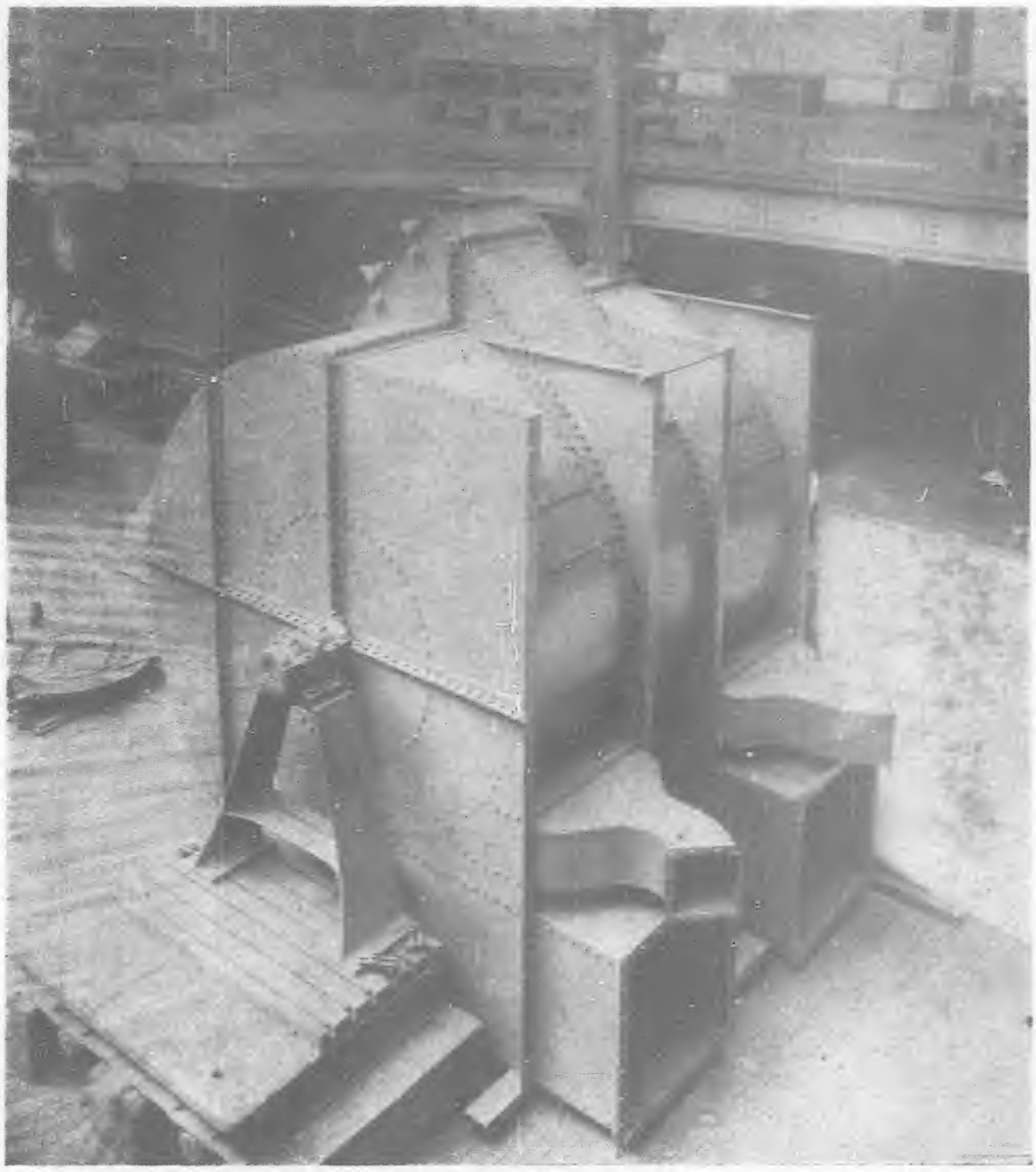
Notable New Plant for Canton Electricity Station

THE latest standard practice in electricity station operation is the installation of dust collectors through which the whole of the combustion gases are passed before discharge from the chimney. The amount of dust present is enormous, being anything from 0.25% to 15.0% by weight of the coal fired, and in most cases within a range of say 2.5% to 10.0%. To some extent also the figure depends on the ash content of the coal, while pulverized fuel firing as a rule gives more dust than mechanical stoking.

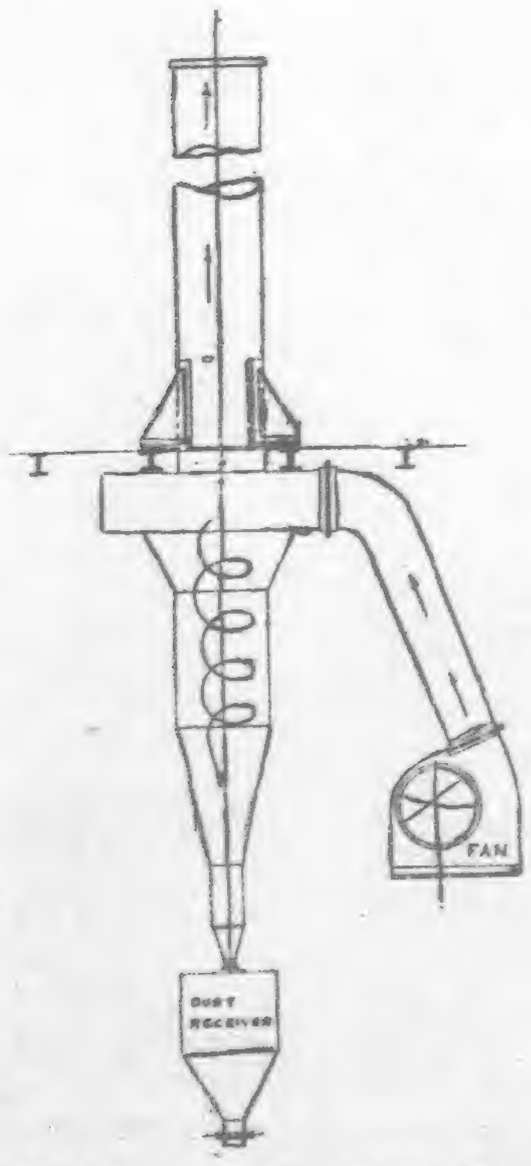
It was very largely due to the pioneer work of Messrs. Davidson and Co., Ltd. of Belfast, who a few years ago perfected their centrifugal dust collector, that the amount of dust discharged from power station chimneys was first realized. Over 600 of these collectors are now operating on power station and industrial boiler plants and the problem of removal has been solved to such an extent that on the average 85/95% of the total dust in the gases is being separated, in spite of the enormous volume concerned, approximately 500,000 cubic feet at say 250/450° F. per ton of coal burnt.

In this connection great interest attaches to an equipment of "Sirocco" induced and forced draught fans and "Davidson" dust collectors that has just been constructed for the Canton Electricity Station of the Kwang Tung Electric Supply Co., Ltd.

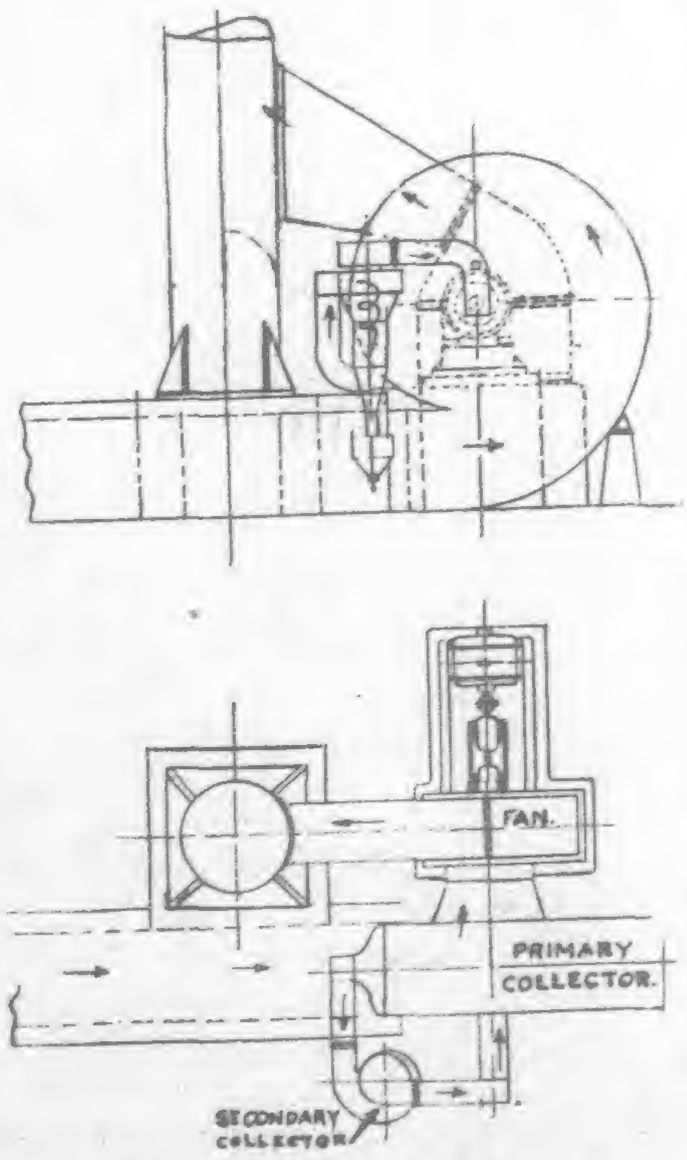
Three general types of these collectors are available, that is the "D" (direct), the "S.P." (shunt pressure), and "S.S." (shunt suction), but the basic principle is the same. The "D" type, for example, of which the other two are modifications, consists of a horizontal casing of volute shape, through which passes the dust laden gases travelling round at high velocity. As a result the heavier dust is thrown to the outside by centrifugal force, while because of the volute shape this pronounced separating action gradually increases as the radius of the casing diminishes. From the top the dust-free gases pass out by a trunk leading to the suction of a fan, which discharges to the chimney, and at the bottom of the volute casing is a large diameter cone, terminating in a dust outlet leading to a closed collector chamber, the separating action on the dust particles being also assisted by gravity.



"Davidson" Dust Collectors Integral with Double Inlet "Sirocco" Induced Draught Fan for Canton as assembled in the Shops at Belfast. When Installed Inlet to Primary Collectors will Point Downward and not Horizontally as shown



Davidson Patent "D" Type Dust Collector under Pressure



Davidson Patent "S.S." Type Dust Collector

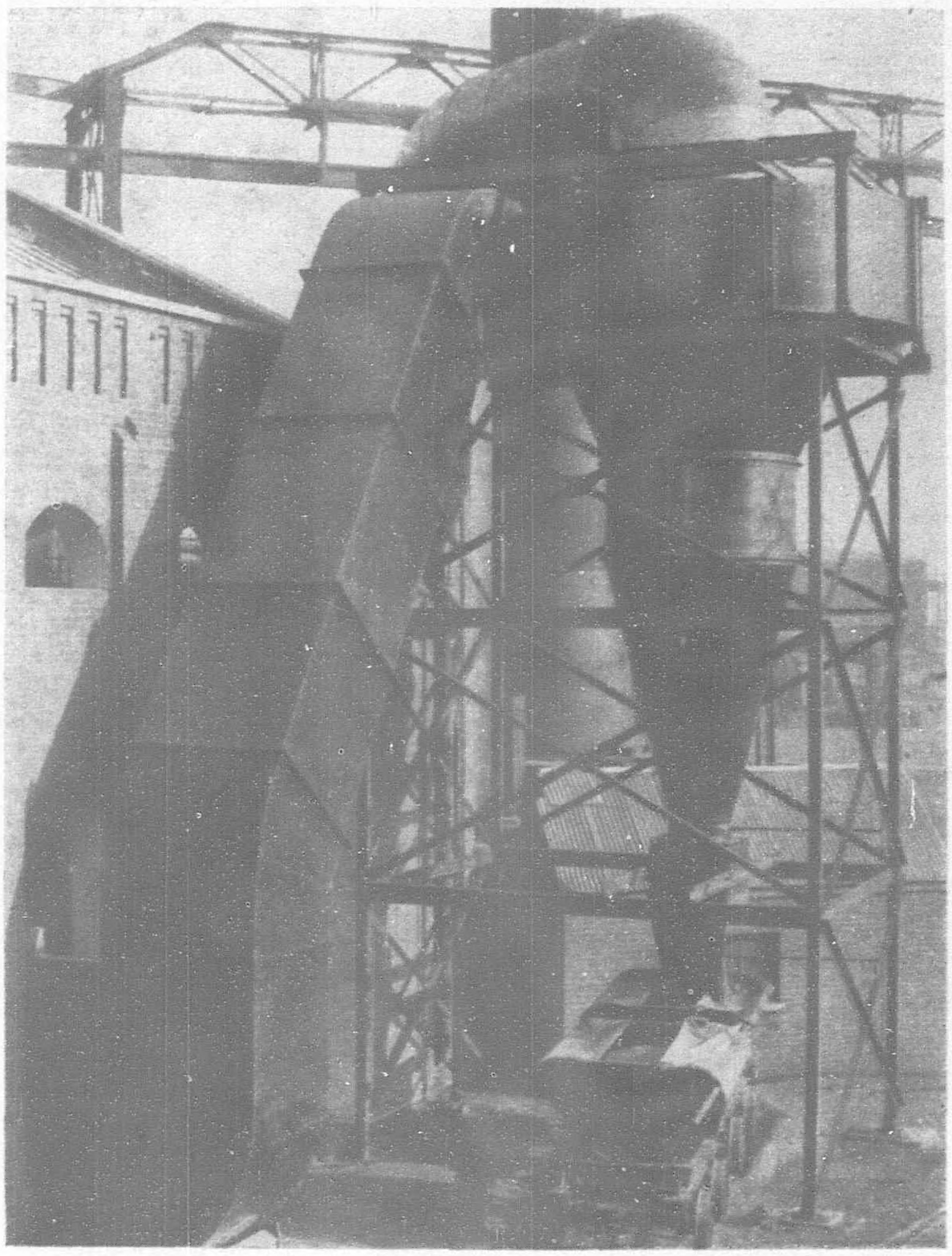
The latest scientific practice also is now to have the collectors on the suction side of the fan, which has solved the extremely serious problem of fan erosion due to the sand blast action of the dust in the combustion gases under the modern conditions of very high suction required, which means of course a great increase in the velocity of the combustion gases going through the fan casing as compared with standard practice of only a few years ago.

For Canton the equipment consists of one 49-in. special double-inlet "Sirocco" induced draught fan, two 39-in. Davidson "S.S." primary dust collectors in conjunction with two 13-in. Davidson "D" Type secondary collectors, and one 35-in. double-inlet "Sirocco" forced draught fan. The maximum duty of the latter is 37,000 cubic feet of air per minute at a temperature of 80° F, direct driven by a 42 b.h.p. electric motor, while as regards the induced draught fan the corresponding figure is 69,000 cubic feet of combustion gases per minute at an average temperature of 440° F, when running at 690 revs. per minute, the fan being direct driven by a 95 b.h.p. slip-ring induction motor running as desired within a range of 350/690 revs. per minute. Also this installation of induced draught and forced draught fans and dust collectors is to operate in conjunction with boiler plant supplied by The Stirling Boiler Co., Ltd.

Essentially in the "S.S." (shunt suction) collector, as installed at Canton, the bulk of the separation of dust from

the combustion gases takes place in the main collector, in this case 39-in. diameter, and from the periphery, at a point of minimum radius, practically the whole of the dust and a small proportion of the gases then pass into a smaller diameter " D " Type secondary collector when final separation takes place, the dust extracted being removed from a closed collecting chamber as required.

Further, in this installation for Canton both the " S.S." collector casings form an integral unit with the double inlet induced draft fan, being arranged at the suction inlets of the latter connection to each Secondary " D " type collector being made by means of small rectangular trunking, the whole representing an extremely neat and compact arrangement. It will be noted that separation



Davidson Patent "D" Type Dust Collector Applied to "B and W" Boilers at the Beckton Works of the Gas, Light and Coke Co., London, 17 Tons of Dust Weekly being separated

of the dust takes place before the entry of the gases into the induced draught fan at each side, and in this connection it may be stated the first power station to be completely equipped on this general principle, with the collectors in parallel to prevent fan erosion, is Ironbridge, near Shrewsbury (England), which has just been officially opened, the arrangement being such that any number of collectors can be cut out as desired according to the variation in the boiler operation so as to maintain maximum efficiency.

Further with regard to the Far East, it may be stated that interesting installations of " Sirocco " induced and forced draught fans are at the Shanghai Station, and at the Nagoya Station of the Tokio Electric Light Company.

Agricultural Implements in Philippines

Trade Commissioner E. D. HESTER, Manila

THE almost continuous decline since 1924 in the average price of Philippine agricultural exports from over 25 centavos per kilo to 13 centavos, and the coincident declines in prices for the important domestic crops, rice and corn, has added to the natural causes discouraging farm mechanization and helps account for the steady reduction in value of imports of agricultural implements. For 1931 these imports were just under 200,000 pesos (the peso equals $0.50), as compared with 247,000 pesos in 1930 and 267,000 pesos in 1929. The United States increased its predominant position in the implement trade in 1931 at approximately 184,000 pesos, or 83 per cent of the total, as compared with 207,000 pesos, or 83 per cent, in the previous year. These figures exclude agricultural tools amounting to approximately 150,000 pesos, tractors amounting to approximately 300,000 pesos, and rice threshing and hulling machinery amounting to 116,000 pesos.

The Philippine demand is for the most simple types—especially in plows and cultivators. The organization of agriculture is such as to preclude the economic use of geared machinery. Rice is produced in small paddies or terrace fields having an average size of less than an acre, and is transplanted from seed bed to field and weeded and harvested by hand. Rice threshers gained headway in the more developed level regions in Nueva Ecija until recent years, when abundant labor and the low price of the commodity forced the few plantation owners to adopt the native " aparcero " or subtenant system to their areas. Corn is grown largely on hillsides, except in the Cagayan Valley, where small fields similar to the rice paddies are used. In corn cultivation, almost the only implements are the native plow, a fork trunk shod with an iron casting, and a crowbar, the latter used for removal of stumps and large stones. Coconuts, a tree crop, are not cultivated. In tobacco, where cultivation is perhaps better than in other crops, the extremely small holdings make impracticable the application of any machinery. Abaca, or Manila hemp, also a tree crop, is largely produced on small holdings or, when on large plantations, by subtenancy. Cultivation is by hand and no machinery is on the market for the actual production, although small gasoline engines are now commonly used in the Cavao district in the process of stripping the fiber.

The actual types of implements employed are shown in the following table, together with the principal competitors in each. Germany presented insignificant competition in cheap plows and miscellaneous implements, and Japan in miscellaneous implements only.

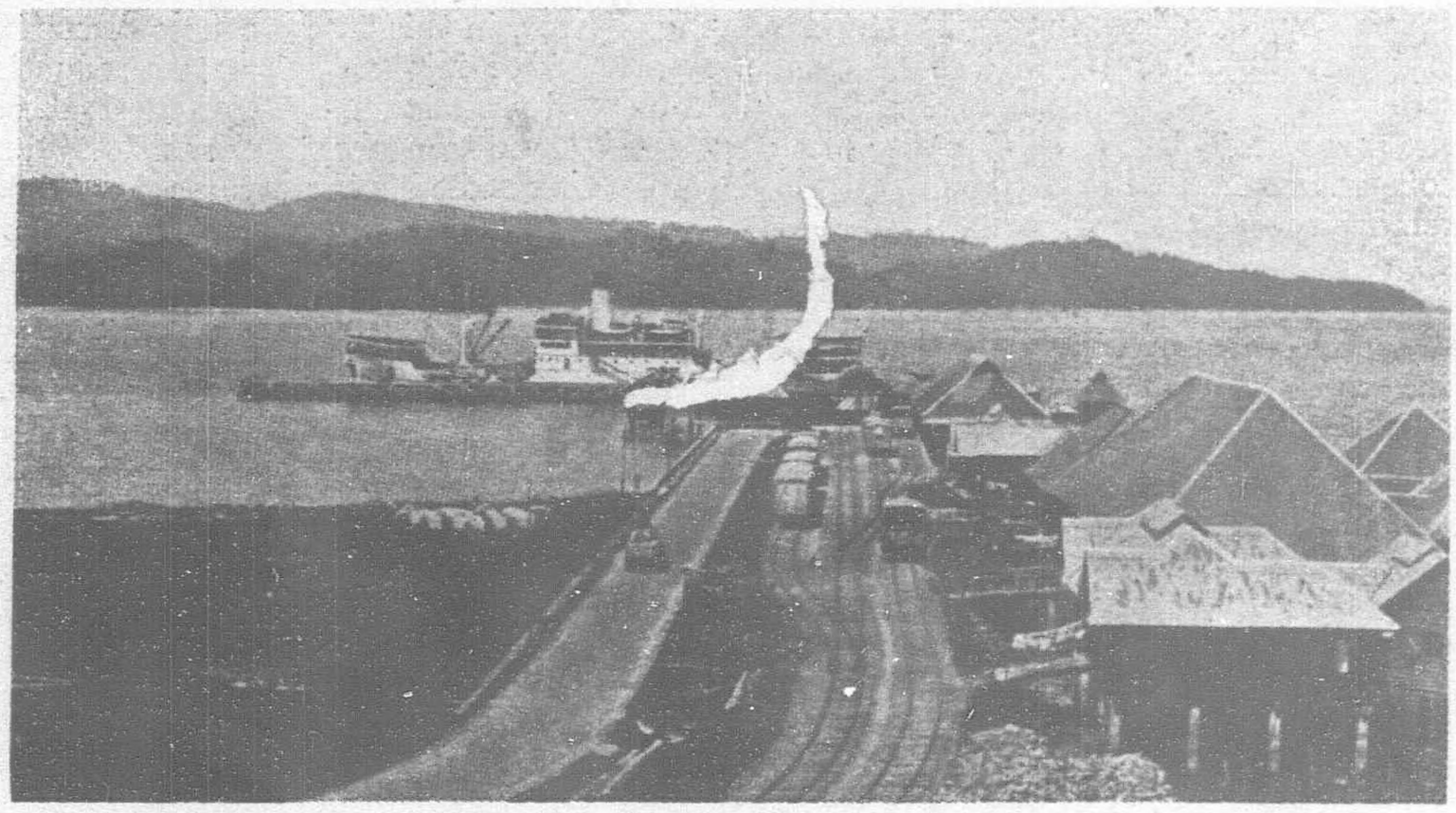
Value of Philippine imports of agricultural implements (except tools)

Item and country of origin	1930	1931
	Pesos 1	*Pesos 1*
Plows, cultivators, and harrows	164,396	105,398
United States	146,827	104,362
Germany	14,305	308
Reapers and mowers	28,347	27,153
United States	28,347	26,556
Germany	—	587
Other implements	54,666	67,219
United States	32,118	52,734
Japan	14,066	8,067
Great Britain	377	3,677
Germany	7,307	2,382
Total	247,409	199,770
United States	207,292	183,652
Germany	21,612	2,690
Japan	14,066	8,067
Other countries	4,439	5,361

As customs statistics do not carry the numbers of the items imported, it is impossible to draw up any clear analysis of prices. Reductions in most cases were moderate, if any, either by importers of American or foreign implements.

No particular improvement is in prospect, either for 1932 or the immediate future. Agricultural income is at low ebb, especially in rice, sugar, hemp, and copra. Under these conditions, farmers and planters will limit purchases of replacements and will make no additional investment.—*Commerce Reports*

The British North Borneo State Railway*



Jesselton Wharf with the s.s. "Darvel"

ONE of the most interesting railway systems in the Far East is the 124½ miles of meter gauge built and operated by the British North Borneo Chartered Co., on the West Coast of their territory. Apart from the variety and picturesqueness of its surroundings, it is notable as a feat of engineering skill of no small dimensions; for as many a surveyor has learned to his cost, primary jungle, however beautiful, in a land scored with hilly ranges and intersected by many streams, is not an ideal country for railway construction.

The first section from Beaufort to Weston, a distance of twenty miles, was completed in 1900; the second section, joining up Beaufort and Jesselton—fifty-seven miles—was completed in 1902, while the third section of thirty miles, running from Beaufort to Tenom, occupied about seven years of strenuous and unremitting labor before it was opened to traffic in 1905. The latter section winds through the magnificent scenery of the Padas River gorge; but the writer doubts if Messrs. West and Ashton Pryke, who were responsible for its construction, appreciated its beauties when they were battling with its difficulties. They had to fight for every foot of progress against constant landslides; sometimes thousands of tons of rock and earth falling across the line; floods, which strewed the track with huge boulders and innumerable washouts. However, pluck and persistence conquered, and the first train rolled into Tenom on April 5, 1905. Subsequently an extension of nine miles was built from Tenom to Melalap.

In 1912 a scheme of reconstruction was commenced. The wooden bridges were replaced by modern steel structures, the dangerous curves were straightened out, and on the main line from Jesselton to Beaufort the 30 lb. rails were replaced by 60 lb. rails. Locomotive workshops were built at Tanjong Aru, and the B.N.B. State Railway blossomed from a light experimental railway to a full grown system.

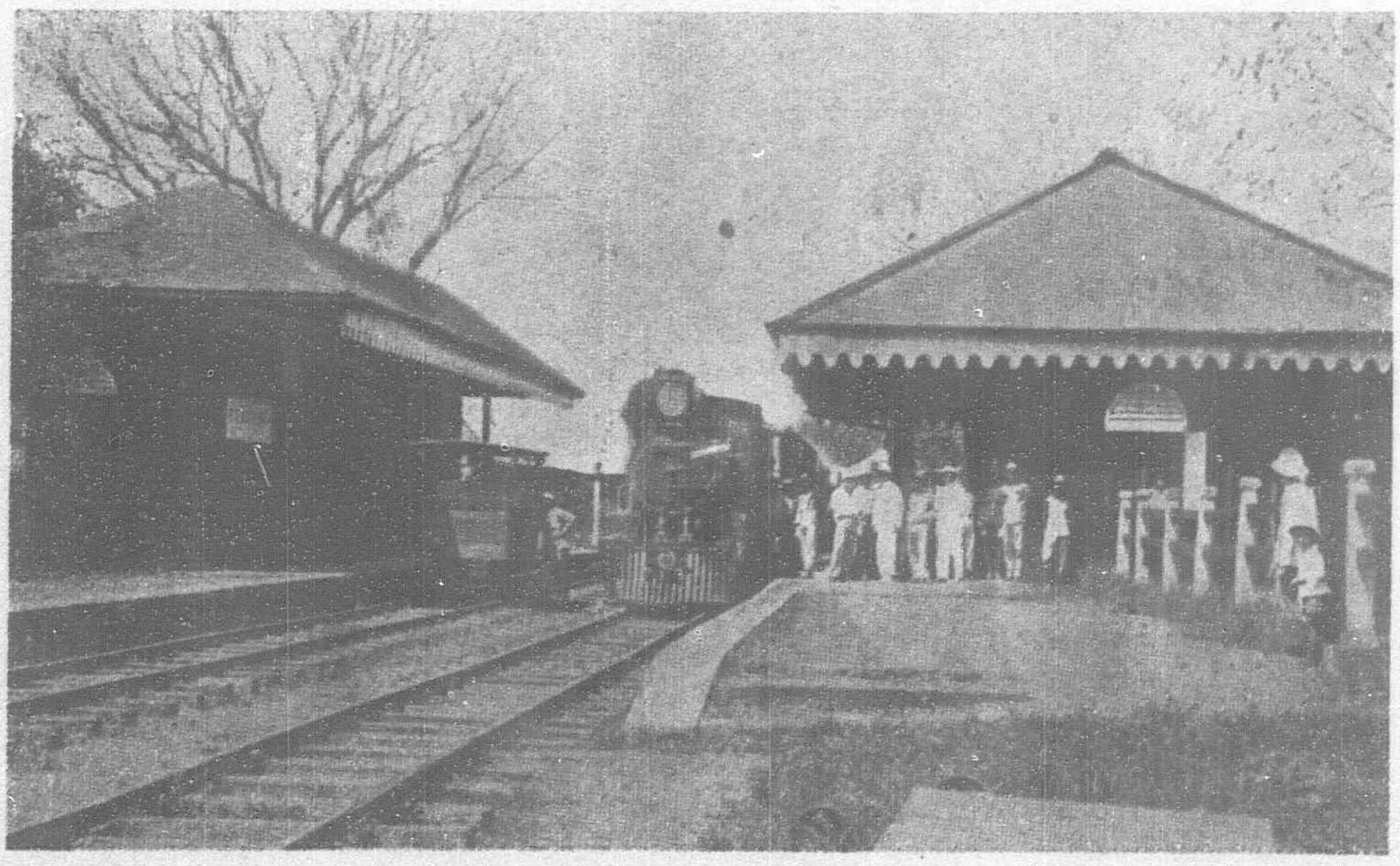
The types of locomotives in use are tender engines (4—6—0) and tank engines (4—6—4, 0—6—4, 0—4—2), burning wood fuel. The rolling stock consists of first, second and third class coaches and composites. For goods there are covered vans, low-sided trucks, cattle trucks, timber trucks and brake vans. The railway also boasts a coach de luxe, reserved for the use of the Governor and his distinguished visitors. This coach was entirely designed and constructed in the Tanjong Aru workshops, and is a most creditable and artistic piece of work. It consists of one long compartment designed for coolness and comfort. The interior is panelled in ornamental native woods, and fitted with tables and revolving armchairs. There is a roomy observation platform at the rear, and last, but not least, a most efficient ice-chest.

There are also two or three motor trolleys fitted to the gauge and which can be chartered for emergency journeys. One of these carries coach work which one seems to remember as having once graced the chassis of Jesselton's original "Tin Lizzie." Last of all there is the humble coolie power trolley. The latter mode of progression is not to be despised when there is a journey to be made and no train available. A rattan chair is lashed to the middle of the flat truck, and four coolies sit side-saddle, one on each corner and push on the sleepers with the off side foot. This mode of transit is not without its little excitements, for there are many steep grades and apparently no brakes. The "motive power" jumps aboard and yells with delight as you go careering down the track. Around the corner you may come face to face with the returning train, and then, if time permits, the trolley is hastily dismantled and dragged off the line. If time does not permit, you make a jump for it, and collect your scattered kit when the train has passed by.

Landslides and washouts still occur on the Tenom section, sometimes burying the line for hundreds of yards; but the only obstructions on the Jesselton-Beaufort section seem to be fallen trees and wandering cattle. The kerbau, or water buffalo, is one of the native's most valued possessions. It is also one of the most obstinate beasts alive, and if it wishes to browse on the permanent way it will do so with utter disregard of the consequences to trains or itself. When accidents of this sort began to occur, the Government compensated the bereaved owner. It was an error of judgment, for the natives hailed it as a profitable means of disposing of a worn-out kerbau, and cattle accidents increased in frequency. Then the Government changed its tactics and imposed heavy fines on the owners of kerbaus found straying on the line. The result was curious. In normal circumstances the native loves his kerbau, and will engage in long and acrimonious lawsuits over the ownership; but thereafter when a kerbau was found straying on the line, nobody claimed it.

During 1923-24 the whole working system was reformed and placed upon a profitable basis. The daily service on the Jesselton-Beaufort section is now reduced to one departure each way on Sundays, Tuesdays, Thursdays and Saturdays. Beaufort-Tenom-Melalap; one each way on Tuesdays and Saturdays. Beaufort-Weston; one each way on Sundays, Tuesdays and Thursdays. There is also a daily local service operating between Jesselton and Tanjong Aru.

As far as recollection serves, the Beaufort train leaves Jesselton at 8.30 a.m., and after passing the halts at Karamunsing (familiarly known as "Marble Arch") Government House



Beaufort Station

* *Eastern Engineering and Commerce.*

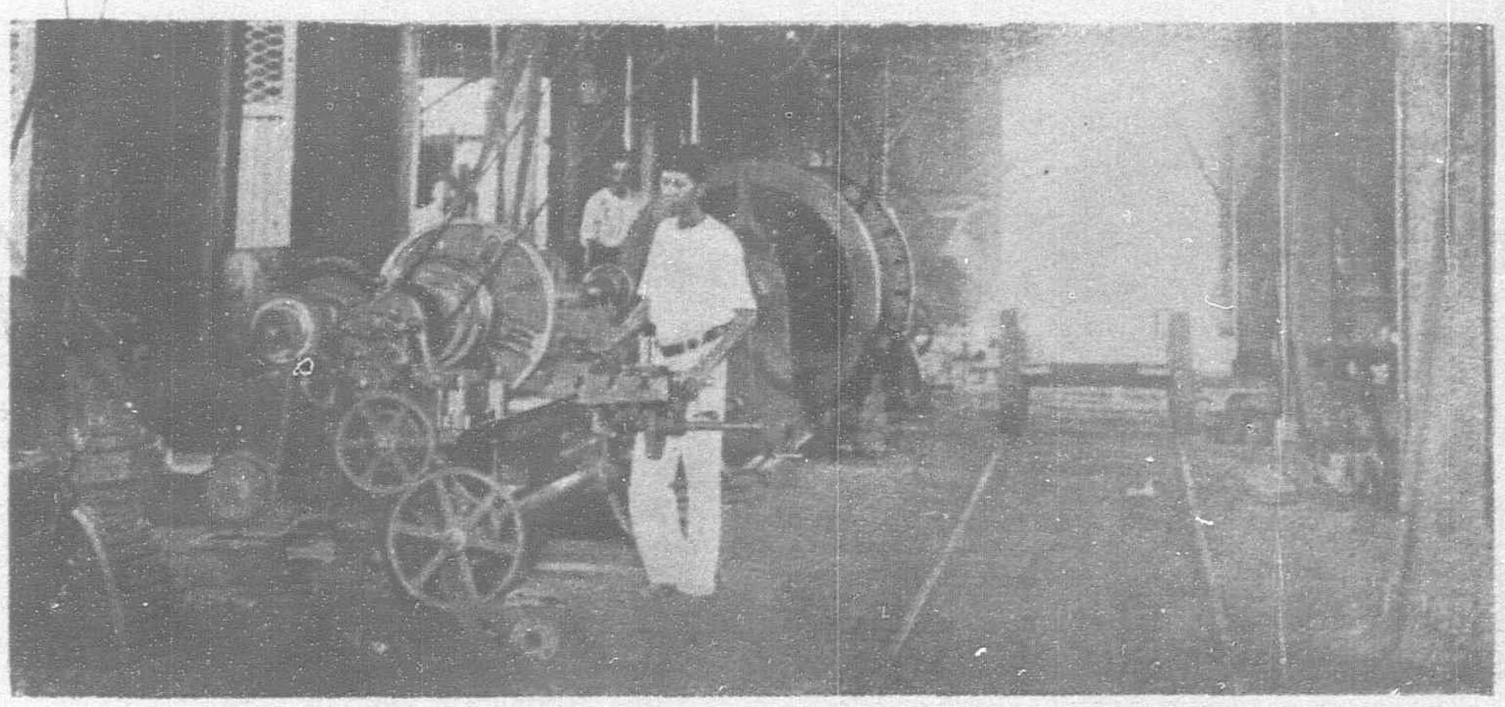
halt, and Victoria Barracks, stops at Tanjong Aru. After being taken on by a larger engine it continues on its way through flourishing rubber estates, whose development has been mainly due to the railway, past the stations of Putatan and Kinarut to halt again at Papar, where both locomotive and passengers take refreshment. Papar is quite a sizeable station, and has been the scene of more than one stirring incident in Government history.

Leaving Papar it passes through Kimanis, Bongawan and Membakut to Beaufort, the terminus of this section.

On the way one gets a glimpse of the beautiful little Bay of Benoni, notable as a honeymoon resort and for its mythical prehistoric monster, whose presence, by the way, has not been reported for some years. Perhaps it disapproves of honeymoons.

At certain times of the year, after the heavy rains, the river rises and floods Beaufort, sometimes to the extent of eight feet. On these occasions the train ploughs into the station throwing up a four-foot bow wave ; the inhabitants go about their business in sampans, and the members of the club, who are in the majority Scotsmen, keep an anxious eye on the water for fear that it should reach the level of the bar counter.

There has been more than one rumor of a scheme for joining up Jesselton, on the West Coast with Sandakan on the East Coast, not only by road but by rail, thereby developing the interior and its untouched riches, and shortening the transport from coast to coast by about two days. It is a dream that many would like to see materialized, but the labor and cost would be enormous, and unless rubber—which is one of the country's chief industries—becomes a little more resilient, it will remain a case of " East is East and West is West, and never the trains shall meet."



Machine Shop at Tanjong Aru

Concrete Road Construction

At a meeting of the Engineering Association of Malaya, the following paper on Concrete Road Construction was read :—

The work forms part of the 1932 " New Roads " Program, and has for its purpose the opening up of a new industrial area in the vicinity of Tiong Bahru and Alexandra Road, Singapore.

The road is 6,200 feet in length and has an 80 feet formation width made up of a 30 feet reinforced concrete carriageway, 20 feet side-tables (which will accommodate all future mains and services) and five feet wide semi-permanent drains on both sides.

Earthworks were carried out by contract during the first half of year 1931, entailing the excavation and filling of about 36,000 cubic yards of earth. The contract price for this work worked out at about 20 cents per cubic yard. Average depth of fill was 2-ft. 9-in. and cut 4-ft. 6-in.

The carriageway is being constructed to easy gradients—the steepest of which is 1 in 40. All curves are super-elevated. The formulae=$.03V^2/R$,* e being the cross-fall per foot width, has been used as a guide for determining super-elevations calculated for a speed of 30 miles per hour, with a ruling cross fall of 1 in 15. The amounts adopted are as follows :—

Radius of curve.	*Super-elevation on 30 feet width carriageway.*
60 feet	24 inches (maximum permissible)
400 ,, ...	24 ,,
700 ,, ...	15 ,,
1,360 ,, ...	12 ,,
1,000 ,, ...	12 ,,

The full super-elevation is given on whole length of any curve, and is shaded off from the tangent points to normal cross-section at a 1% grade.

Semi-permanent 12 inch precast-channelled drains were laid in advance throughout the entire length of road, and this enabled adequate drainage of the subsoil.

Subgrade was prepared by covering the red-earth subsoil with a 6-in. layer of either brick-rubble, or other hard core and ashes, rolled to grade and camber with 8½ ton petrol rollers. A layer of sand or granite dust one inch thick is being spread over this to reduce friction between concrete slab and subgrade, the material being watered before concrete is placed to prevent absorption of water content in mixture.

The concrete road proper is being carried out by a local Chinese Contractor with materials, tools, and plant supplied by the Municipal Commissioners.

The carriageway has a clear width of 30 feet between kerbs, and the road surface has a 4-in. or 1 in 45 camber. It is being formed according to the half-width-strip continuous-bay system, transverse ½-in. joints over 2-ft. 0-in. × 8-in. reinforced underslabs being provided at 40 feet intervals, the two strips forming a longitudinal construction joint along middle of the carriageway.

Stone for the concrete mix consists of granite from the Municipal Commissioners' Quarry at Mandai crushed at Tanjong Pagar Depot. The proportions for stone are one part 2½-in., one part 1½-in. and two parts ¾-in. grade. The sand is obtained from the Dutch Islands and grading is such that not more than 10% passes a 50 mesh sieve. Japanese Rapid Hardening Cement is being used in paper bags weighing 110 lbs. each.

The carriageway reinforcement is fabricated on site by Contractor from rolled mild steel rods. It is of the oblong mesh type, longitudinal ⅜-in. dia. rods 9-in. at centers forty feet long being wired at each crossing of ¼-in. dia. transverse rods at 6-in. centers thirty feet long to form a complete sheet for each bay. This material weighs 7½ lbs. per square yard and is being laid 2-in. from the bottom of slab. This distributed steel reinforcement is calculated to give satisfactory crack control.

The concrete is being machine mixed in proportions 1 : 2½ :. 5 to a 3-in./4-in. slump consistency. It is being laid as one 8-in course in 2-in./3-in. layers pneumatically tamped. This slab thickness has been designed to withstand safely a maximum wheel load of 3½ tons calculated on the basis of a plain concrete section.

Road surface is finished by use of longitudinal straight edges and transverse hand tampers and smoothing boards.

Curing of concrete is being effected after surface has been smoothed off and finished by spraying on " Curcrete " bituminous emulsion—before concrete has set. This is done with portable pressure sprayers at the rate of one gallon " Curcrete " to 10 square yards surface. This emulsion breaks after short exposure to the air and forms an impervious adherent film which retards the evaporation of water from the concrete after it is placed and during the maturing period, thus ensuring complete hydration of the cement and production of concrete of maximum strength. This covering also gives increased resistance to surface wear and weathering.

Estimated unit cost subgrade work .. 75 cts. per square yard.
Estimated unit cost complete 8-in. .. Labour 33¼ cts. per sq. yd.
Reinforced concrete carriageway .. Materials and Haulage $2.75 sq. yd.—*Malayan Tin and Rubber Journal.*

*Full theoretical super-elevation is $e=0.067V^2/R$.

Engineering Notes

INDUSTRIAL

RAYON MILL.—Messrs. Sumitomo Goshi Kaisha, Ltd., are arranging to erect a large new rayon mill near Yokohama.

NEW BUILDING.—Tenders are being invited for the construction of new four-story building for the Chinese Ministry of Foreign Affairs, at Nanking. The structure is estimated to cost $600,000 and an appropriation from the British portion of the Indemnity Refunds, has been secured for the work.

SIAM GETS BREWERY.—As a result of Phya Bhiromya Bhakd's recent European tour a beer brewing plant, valued at Tcs. 400,000, will soon arrive in Siam as per the Chao Khun's order. A German expert will also come out to erect the same. At present Nai Prachuab Sreshthabutr, son of the Chao Khun, is prosecuting further studies in Germany.

CANTON PROJECTS.—The Mayor of Canton, Mr. Liu Chi-wen, announced that the local municipal authorities were contemplating two huge industrial projects.

The first of these, he said, would be a large gas works and the second a new steel bridge across the Pearl River in addition to the bridge now under construction, which will be opened in the New Year.—*Reuter.*

SHOWA STEEL PLAN.—A conference is to be held in Tokyo shortly to settle details of the Showa Steel Works plan. This question has been pending for three years. The factory is to be built at the Anshan Iron Works. Capitalization will remain at Y.100,000,000. The hot process, in which the molten iron from the smelters is run direct into the steel furnaces without being allowed to cool, will be employed.

NEW POWER PLANT.—Despite financial stringency as a result of the Yangtze flood disaster last year, during the period of which a heroic effort was maintained throughout to supply water tc the entire population, the management of the Hankow Waterworks & Electric Light Co. is now undertaking to erect a new electric power plant and also planning to extend and improve present methods of supplying water to the city.

TO HARNESS YANGTZE.—Engineers of the Ministries of Communications and Industry and the National Reconstruction Commission are conducting an inspection of the Yangtze River to study the possibilities for hydro-electric development. It is understood that upon conclusion of the tour a Water Power Conference will be called to discuss steps for realizing the project to construct a hydro-electric station for the harnessing of the mighty Yangtze to industrial purposes.

RAILWAYS

RAILWAY LOAN.—A loan agreement between Chekiang and a financial syndicate at Shanghai for the completion of the Hangchow-Kiangshan Railway has been drafted. To obtain funds for the completion of the line, the provincial authorities have agreed to transfer control of the Hangchow, Yashih, Yuhang, and Szean electric works as security.

TOKYO UNDERGROUND.—The Tokyo Rapid Transit Co. (in process of formation, with a capital of Y.30,000,000) has applied for permission to take over from the Tokyo Municipality the latter's chartered underground lines. Some forty leading business men are interested in the enterprise, and it is expected that the railway authorities will grant the application.

RAILWAY LOAN.—The issue of a $32 million loan for the redemption of the Japanese mortgage on the Kiaochow-Tsinan Railway has been definitely decided upon by the Board of Directors of the Railway. According to Mr. Ko Kwang-ting, Chairman of the Administrative Committee of the Railway, the loan will be issued either by the Ministry of Finance or the Railway Administration. This will be decided by the National Government.

RAILWAY LOAN.—The Chinese Vice-Minister of Railways, Mr. Tseng Chung-min, announces that the Ministry of Railways is contemplating the floatation of bonds to the value of £2,400,000 for the completion of the Chuchow-Shunchow section of the Canton-Hankow railway and for the purchase of railway material. The security, he said, would be the relinquished British share of the Boxer Indemnity due during the period between January, 1937, and December 1946.

TAKES OVER LINE.—It is announced that the Chinese authorities have taken over the Cheng Tai Railway upon the expiration of this year's loan agreement with the French Company, Societe Francaise de Construction et d'Exploitation de Chemins de Fer en Chine. The Cheng Tai Railway connects Taiyuanfu, in Shansi, and Shihkiachwang. It is 151 miles long and its construction was undertaken in 1904 with a French loan of F. 40,000,000 and Government capital of over $6,000,000.—*Reuter.*

LUNG-HAI RAILWAY WORK.—Construction of the road-bed for the eastern extension of the Lung-Hai Railway from Sinpu (Haichow) to Hsukow, on the Kiangsu coast, having been completed, the laying of the tracks has commenced, with the arrival of a large shipment of rails. In view of the shallow harbor at Sinpu, ships of comparatively deep draught are unable to enter. The Ministry of Railways has therefore planned to build a harbor at Hsukow opposite Siling-tao (island) and extend the railway to that point.

CHINESE LIGHT RAILWAYS.—The Chinese National Reconstruction Commission is reported to be contemplating the construction of two light railways. One of these will be between Chapu, Chekiang, and Wuhu, Anhwei, while the other is to run from Lohsu to Luchow, both of which are towns in Anhwei. The two projects are estimated to cost about $2,000,000 (Mex.) The first will be financed by annuities payable to the Reconstruction Commission by the Changhsin Colliery, while the capital for the second project will be raised by means of public subscriptions.—*Reuter.*

THE TANNA TUNNEL.—A tunnel which on completion will be 4.8 miles in length in the Izu Peninsula in Japan is attracting keen attention in engineering circles. It is the Tanna tunnel. Started more than fourteen years ago, to date a sum of Y.21,500,000 has been spent, and it is probable that more than Y.3,000,000 must yet be spent before the work is finished. The tunnel on completion will be 25,614 feet in length. Of this length, 2,200 feet yet remain to be penetrated. The Tanna tunnel will replace the Gotemba route, skirting Mount Fuji. The interior of Tanna mountain was found to contain hundreds of water veins. Sometimes the workers struck geysers, which paralyzed work for months. At other times, due to earthquakes, crevices broke out in the tunnel and its level deviated as much as six feet. Due to difficulties, the cost of Tanna tunnel is reported to be unparalleled in tunnel construction. The per foot cost is set at Y.960. Great casualties have been taken by cave-ins and sudden on pourings of water. At present the water gushing from seventy crevices within the tunnel amounts to 26 cubic feet per second from the Atami entrance. The Construction Bureau of the Railway Department hopes to penetrate the remaining 2,200 feet some time next year.

SHIPPING

PORT WORK HALTED.—The construction of port facilities at Hulutao, at the terminus of the Tahu han-Tungliang Railway, will be temporarily suspended on payment of part of the loan by the South Manchuria Railway Company to the Dutch company who undertook the project. The works are being taken over by the Manchukuo authorities, according to reliable information.

YANGTZE BRIDGE.—An iron bridge to span the Han River and connect Hankow and Hanyang is one of the schemes designed by Dr. Wu Kuchen, Mayor of Hankow. This will be submitted at the first meeting of the Provisional City Council which is now in process of formation, the members of which will include some prominent foreigners. In the event of this scheme being adopted one year will be the period necessary to complete the construction of the bridge, it is reported.

AVIATION

CANTON AIR FORCE.—Canton, resolved to build up a large air force, has a three-year plan, and preparations are under way for the completion of the first stage. The plan of the military authorities is to bring into existence within the next three years an air force composed of 400 fighting planes. At present Canton has about 40 machines. It is learned that plans adopted also call for the engagement of 30 German aviators for training the Cantonese army fliers.

COMMUNICATIONS

NEW HIGHWAY.—The construction of a highway from Pukow, Kiangsu, to Sinyang, in Honan has been approved by the Chinese Ministry of Railways. The Anhwei and Honan Provincial Governments have accordingly been requested to draft plans and raise funds for the building of the new road. The proposed highway will run south of the Lung-Hai Railway and will cut across central Anhwei into Sinyang, southern Honan.

DYKE CONSTRUCTION.—In order that maximum progress may be made in dyke construction and flood prevention work, the Commander-in-Chief's Headquarters for the Honan-Hupeh-Anhwei Bandit-suppression Forces, in a dispatch to the National Economic Council, instructs that funds and revenues earmarked for this work shall not be diverted to other purposes. The dispatch also states that levy of the authorized Customs Surtax, Special Surtax, and Farm Surtax imposed especially for dyke construction purposes should be continued as heretofore.

RADIO IN JAPAN.—By 1934, it is expected that Japan will have perfected equipment for direct radio-telephone service from Tokyo to Europe, America, Java, Hongkong, Shanghai, Dairen, Formosa, and with ships at sea. This is to be done by the International Wireless Telephone Company which is being promoted by Baron Yoshiro Fujinuma and Messrs. Fusajiro Abe and Shintaro Ohashi. According to present indications, the call fee between Japan and Dairen and Formosa will be Y.8, between Japan and Hongkong Y.12, between Japan and Java Y.20, Japan and America Y.70, between Japan and Europe Y.80 and from Japan to ships at sea Y.25. These fees cover three minute calls in each instance. Actual work on the instalment of the equipment will be begun early in 1933 and it is expected that it can be completed in a year.